Department for Environment and Water
22ADL-1447
7 November 2023

Engagement Summary Report (Part B Appendices)

Adelaide Beach Management Review – Short List Engagement

SHAPING GREAT COMMUNITIES

URPS

Engagement Summary Report (Part B Appendices)

7 November 2023

Lead consultant	URPS Suite 12/154 Fullarton Road (cnr Alexandra Ave) Rose Park, SA 5067 (08) 8333 7999 urps.com.au
Prepared for	Department for Environment and Water
Consultant Project Manager	Zoe Hambour, Principal Consultant zhambour@urps.com.au
URPS Ref	231018_v1_Shortlist_Engagement Summary Report_Part B

Document history and status

Revision	Date	Author	Reviewed	Details
V1	7/11/23	Z. Hambour	-	

We acknowledge the Kaurna People as the Traditional Custodians of the land on which we work and pay respect to their Elders past, present and emerging.

© URPS. All rights reserved; these materials are copyright. No part may be reproduced or copied in any way, form or by any means without prior permission. This report has been prepared for URPS' client. URPS and its associated consultants are not liable to any person or entity for any damage or loss that has occurred, or may occur, in relation to that person or entity taking or not taking action in respect of any representation, statement, opinion or advice referred to herein.

https://urpsau.sharepoint.com/Shared Documents/Synergy/Projects/22ADL/22ADL-1447 - Adelaide Beach Management Review – Community Engagement Services/Reports/Shortlist/231018_v1_Shortlist_Engagement Summary Report_Part B.docx

Contents

Contents i

About this document 2

Appendix A – Information documents 3

Appendix B - Survey questions 4

Appendix C – Verbatim comments from survey 5

Appendix D – Summary of submissions table 284

Appendix E –Written submissions 285

Appendix F - Key stakeholder workshop verbatim activity comments 286

About this document

This document compiles all the appendices referenced in the Engagement Summary Report (Part A)

Adelaide Beach Management Review – short list engagement

Appendix A – Information documents

Have your say on the future of Adelaide's beaches

Future management options



The process so far

In April last year, the South Australian Government announced a comprehensive independent review of all available coastal (sand) management options would be undertaken to find a long-term solution to coastal erosion across Adelaide's beaches.

The 12-month review, which commenced in December 2022, builds upon previous investigations, data and analysis of Adelaide beach management, and explores relevant interstate and overseas examples of coastal management.

Scientific review

The review includes consideration of:

1. How to manage sand on Adelaide's beaches to minimise disruption for all communities, avoid environmental harm and maximise sand staying on beaches.
2. The Adelaide community's views on sand management options and on the impact of the current sand management approaches, including trucking and pipelines.
3. Lessons from international and interstate examples of sand management on metropolitan beaches.
4. What can be learned from the most up to date analysis of climate science about future management of Adelaide's beaches.

The scientific review shortlisted the management options outlined in this document for community consultation.

Details on options that did not make the shortlist are available at **www.environment.sa.gov.au/coasts**.

Why do we need to manage Adelaide's beaches?

Adelaide's coastline is one connected system with sand naturally moving northward due to wind and waves. This causes a build-up of sand on beaches where its northerly movement is interrupted, such as Glenelg and Semaphore Park, and erosion on beaches such as Seacliff, West Beach and Henley Beach South.

As there is only limited new sand naturally entering the system, Adelaide's beaches have to be managed, and have been for nearly 50 years by the state government. The aim is to protect homes, businesses and infrastructure from storms, and to provide sandy beaches for our community to enjoy.

This has been done by moving sand from where it builds up to areas that are being eroded. This has involved trucking sand from one point to another, as well as using a sand recycling pipeline. Sand has also been brought in from external sources, including quarries or offshore deposits.

Without moving sand, some beaches would erode to rock and clay, and rock walls or other sea walls would be required to protect coastal homes, businesses and roads from the sea.

Have your say!

yourSAy

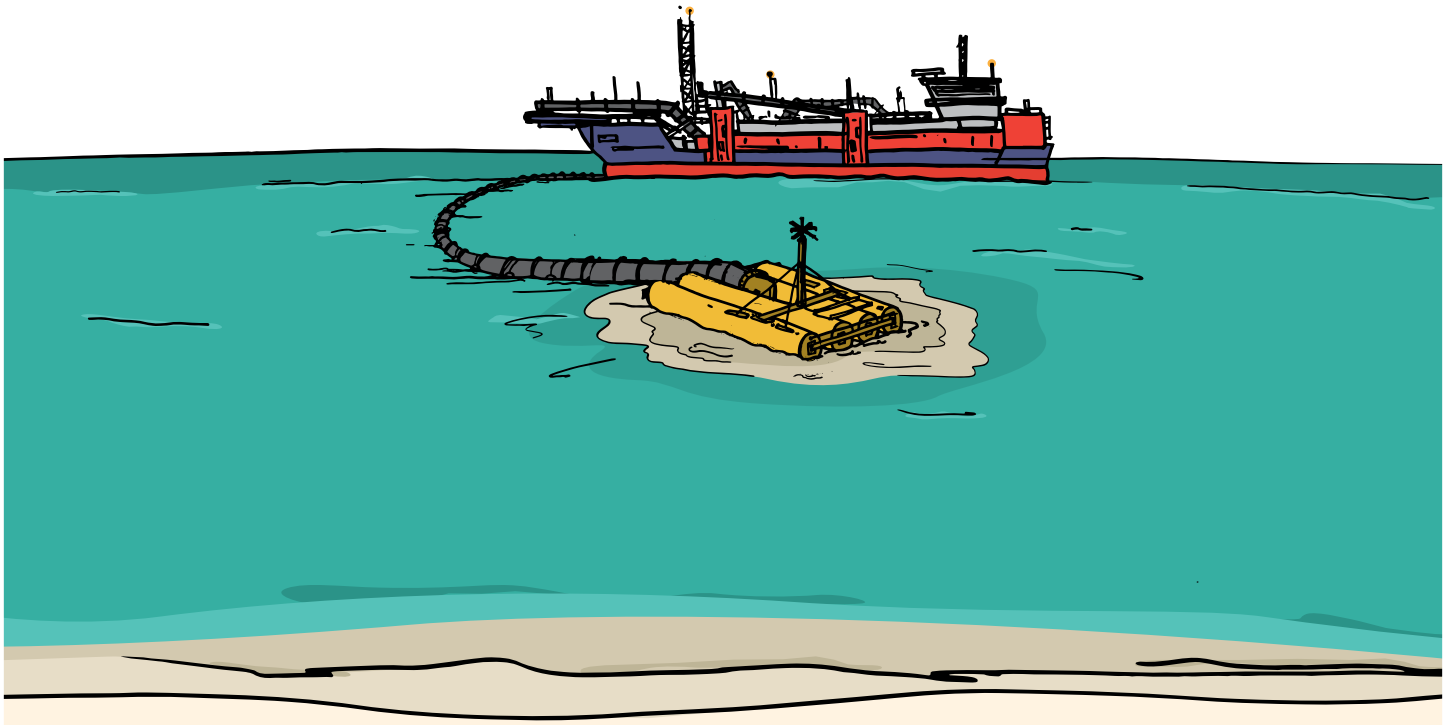
It is very important to the success of the review that it is informed by an understanding of what matters most to the community so we want your views on the different sand management approaches.

We encourage you to submit your feedback on the shortlisted options by using the state government's YourSAy portal at: yoursay.sa.gov.au/abmr-shortlist

Submissions close Sunday, 15 October at 5:00 pm.

Dredging

Dredging would involve sand being collected from the seabed using a dredging vessel and being delivered to West Beach or other beaches in need of sand. This could include taking sand from deposits offshore of Largs Bay, Outer Harbor and/or Port Stanvac.



OPTION 1.1 Dredge existing sand near the shore

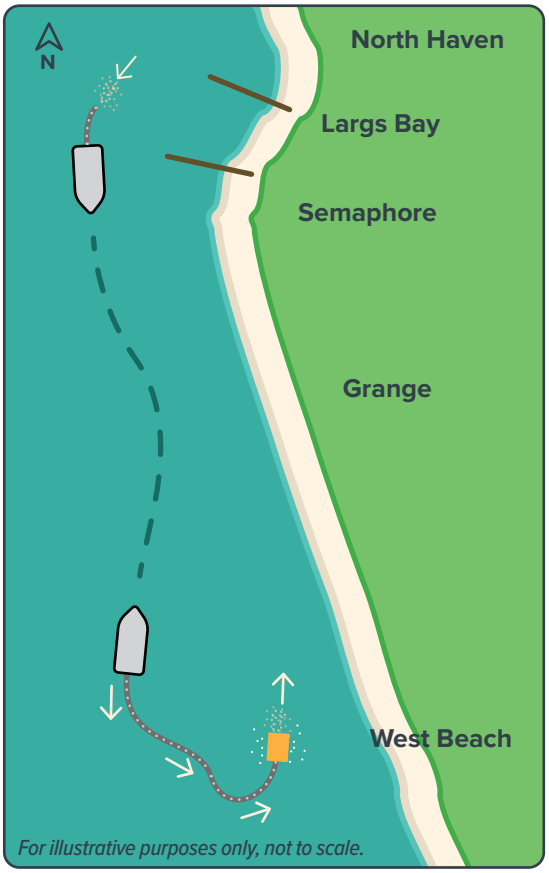
About **2km offshore** of **North Haven** when collecting sand from the seabed and would move to 100-150m offshore of **West Beach** when placing the sand.

Sand would be collected from the seabed using a **small dredge**, which would sail south and pump the sand into **West Beach** using a **floating pipeline** that runs from the **vessel to the shore**, to deposit sand near the shoreline. Sand could also be delivered to other beaches as required.

This option would involve an initial **large quantity** of sand being collected from offshore of North Haven and then delivered to West Beach in the first year of operation and ongoing sand **top-ups** every **4 years.**

The initial collection and delivery of a large volume of sand would be expected to take about **3-4 months**. Ongoing top-ups would be delivered every **4 years** and would be expected take about **2 months** to complete.

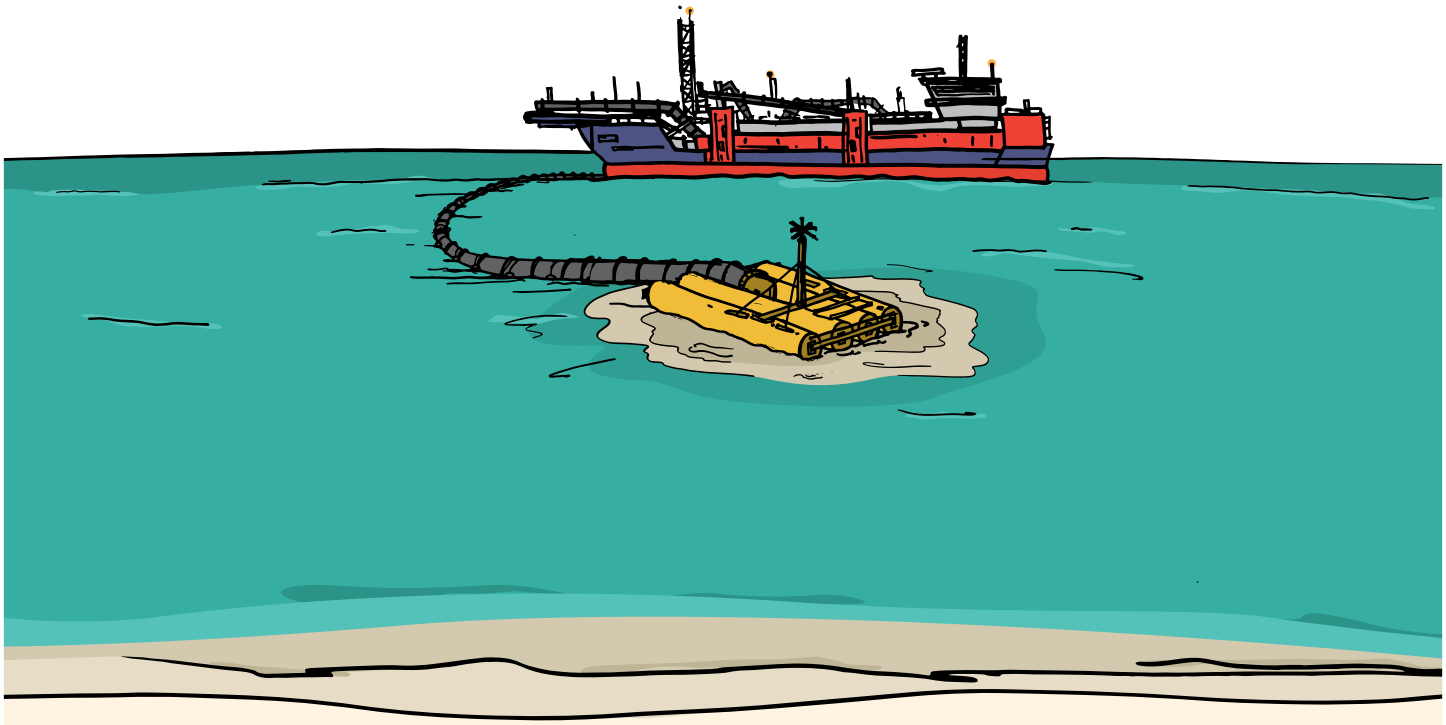
The estimated total **20-year cost** for this method is **$45-50 million** subject to the availability of a suitable dredge.



For illustrative purposes only, not to scale.

Dredging

Dredging would involve sand being collected from the seabed using a dredging vessel and being delivered to West Beach or other beaches in need of sand. This could include taking sand from deposits offshore of Largs Bay, Outer Harbor and/or Port Stanvac.



OPTION 1.2 Dredge using large offshore sand deposits

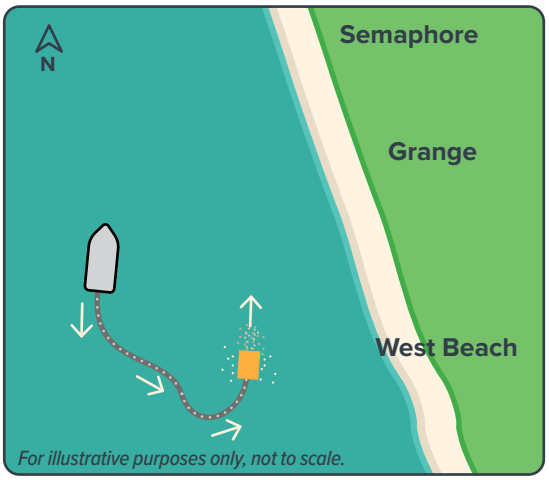
Location about **2km offshore** at the chosen collection site(s) and then 100-150m offshore of **West Beach** when delivering the sand.

External sand could be sourced from the **seabed** at larger offshore deposits, including **Largs Bay**, **Outer Harbor** and/or **Port Stanvac** (subject to further investigations and approvals).

Sand would be collected from the seabed using a **medium-sized dredge**, which would pump the sand into **West Beach** using a **floating pipeline** that runs from the **vessel to the shore**, to deposit sand near the **shoreline**. Sand could also be delivered to other beaches as required.

Delivery of a **very large quantity** of sand from nearby sources would be expected to take **3-4 months**.

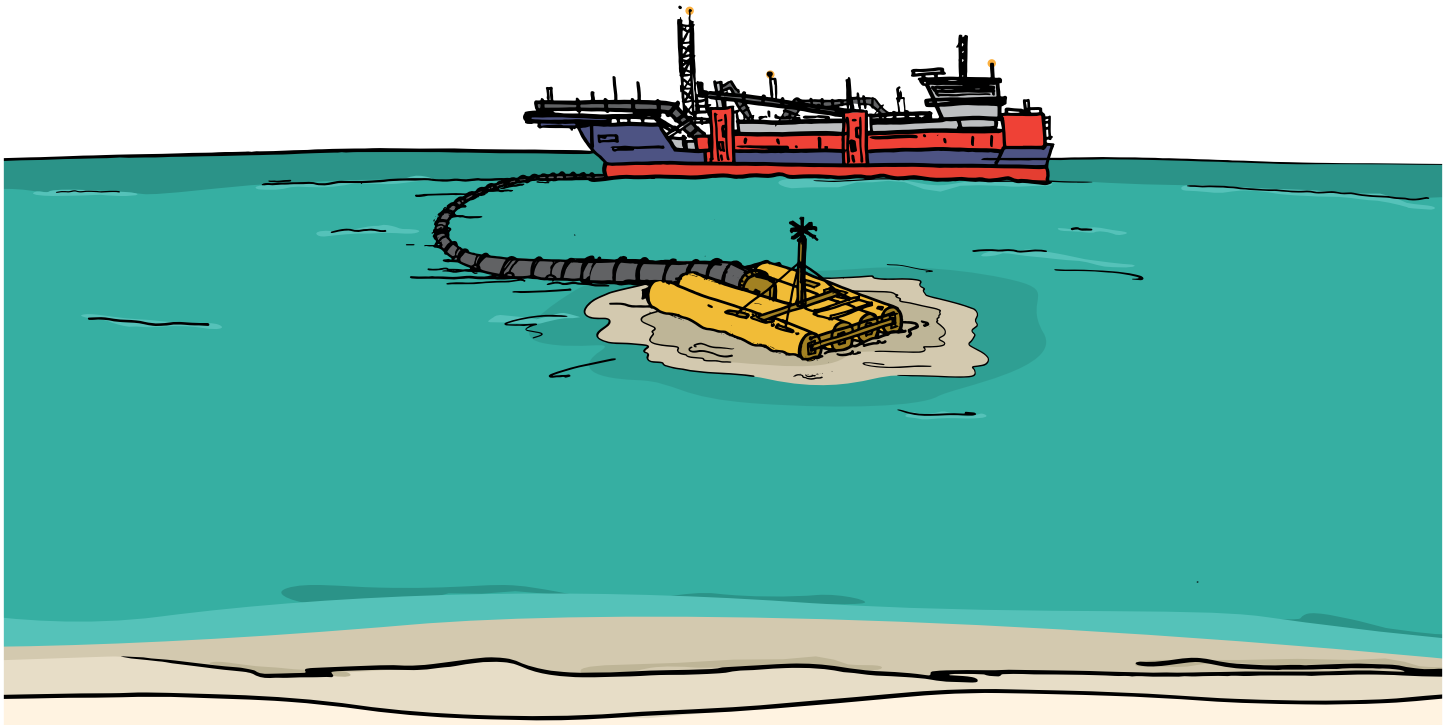
The estimated total **20-year cost** for this method is **$55-60 million** if using **nearby sand** sources subject to availability of a suitable dredge.





Dredging

Dredging would involve sand being collected from the seabed using a dredging vessel and being delivered to West Beach or other beaches in need of sand. This could include taking sand from deposits offshore of Largs Bay, Outer Harbor and/or Port Stanvac.



OPTION 1.3 Combination of dredging offshore deposits and trucking quarry sand

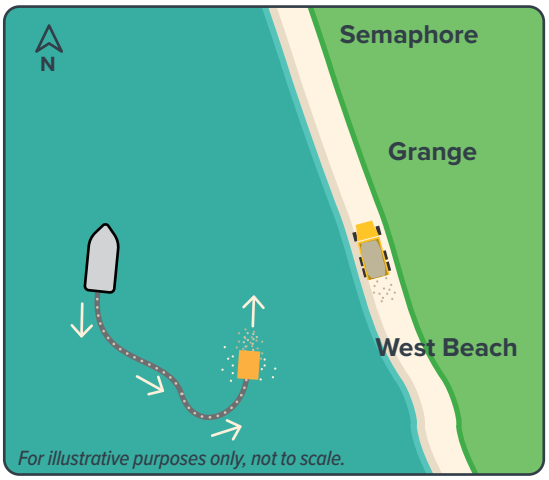
The dredge would be located offshore at the collection site and about 100-150m offshore of **West Beach** when distributing the sand.

External sand could be sourced from the **seabed** at offshore deposits, including **Largs Bay**, **Outer Harbor** and/or **Port Stanvac** (subject to further investigations and approvals). In addition, dredged sand would be complemented with **sand sourced** from **land-based quarries**.

Sand collected by the **dredge** would be pumped as a slurry into **West Beach** using a **floating pipeline** that runs from the vessel to **deposit sand** near the **shoreline**. **Quarry sand** would be delivered on to the **beach using trucks**.

Delivery of a **smaller annual quantity** of **quarry sand** would be expected to take about **3 months each year** for the first **5 years**. Delivery of the **medium quantity** would be expected to take about **3-4 months** every **4 years** commencing from the second year.

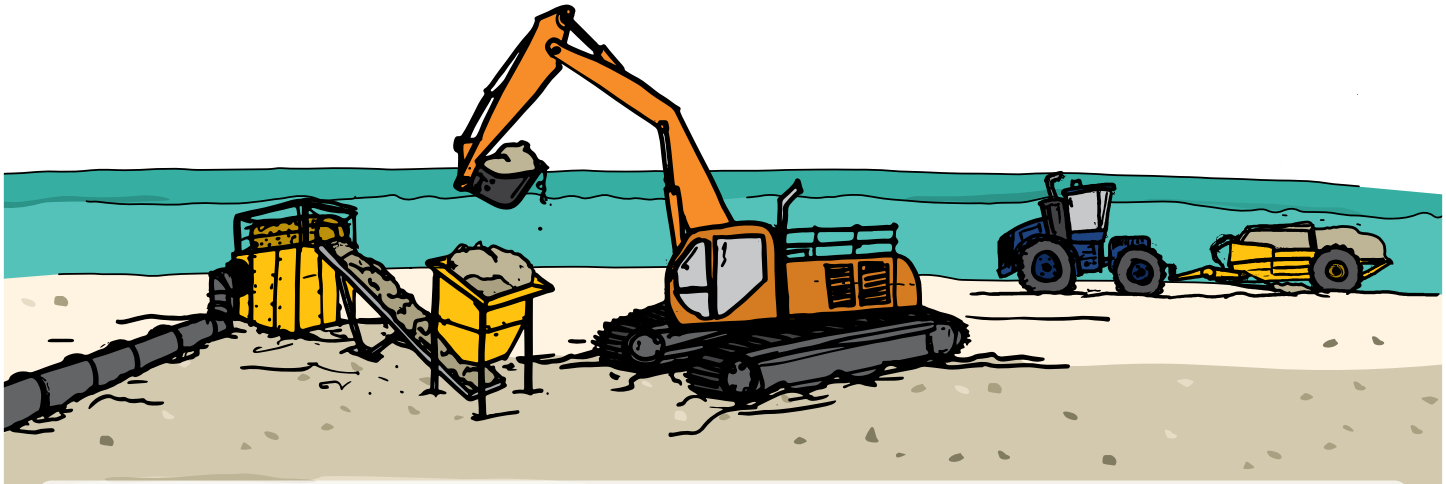
The estimated total **20-year cost** for this method is **$60-100 million** subject to the availability of a suitable **dredge** and **sand deposits**.





Pipeline

Sand pumping uses underground pipelines to transfer sand and seawater from beaches where sand is building up to beaches in need of sand. Operating the pipeline would involve collecting sand from the beach or nearshore for 4 months at a time. Quarry sand would be delivered annually over the first 5-year period to restore West Beach.



A combination of quarry sand and sand collected from dedicated sand harvesting areas between Semaphore Park and Largs Bay would be used. For the pipeline component, sand intake points could be located at Largs Bay, Semaphore and Semaphore South.

The bulk of the pipeline sand would be primarily discharged at West Beach but additional discharge points located along the coastline, including West Beach (Rockingham St), Grange (The Esplanade), Tennyson (Moredun St) and West Lakes Shore (Mirani Ct), would allow sand to be delivered elsewhere as required. Quarry sand would be sourced from land-based quarries and delivered to West Beach using trucks accessing the beach via the Adelaide Sailing Club.

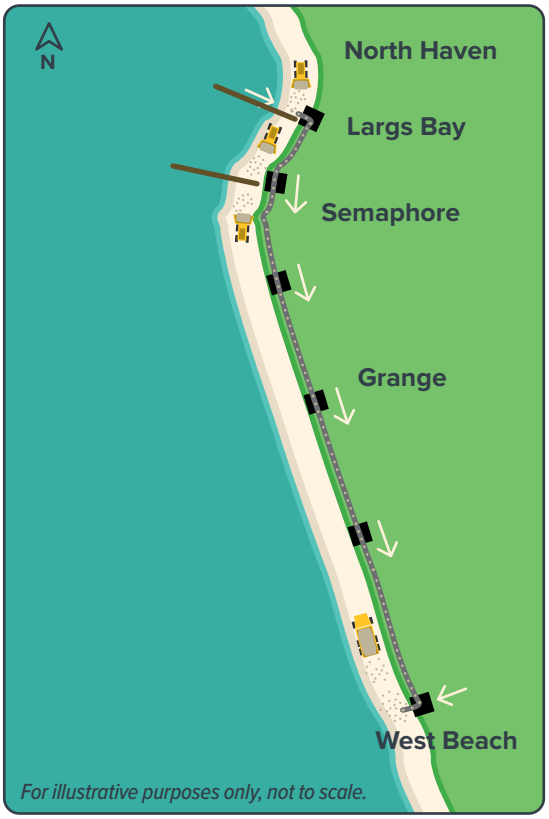
OPTION 2.1 Pipeline using tractors/trucks on beaches

Sand would be collected **onshore** using **machinery** (trucks and scrapers) and fed into the **pipeline** through **sand collection units**. The sand would be **pumped south** through an **underground pipeline** and released at **West Beach** or other locations as required. **Permanent** booster **pump stations** would be located along the **pipeline route**.

Delivery of a **small annual quantity** of **quarry sand** would take about **3 months** each year for the **first 5 years**. Sand collection units would be located at **Semaphore South**, **Semaphore** and **Largs Bay**. Sand would be **collected** from the beach by **tractor** and **sand scraper** around the **Semaphore** and **Largs jetties**, and the **Semaphore South breakwater**.

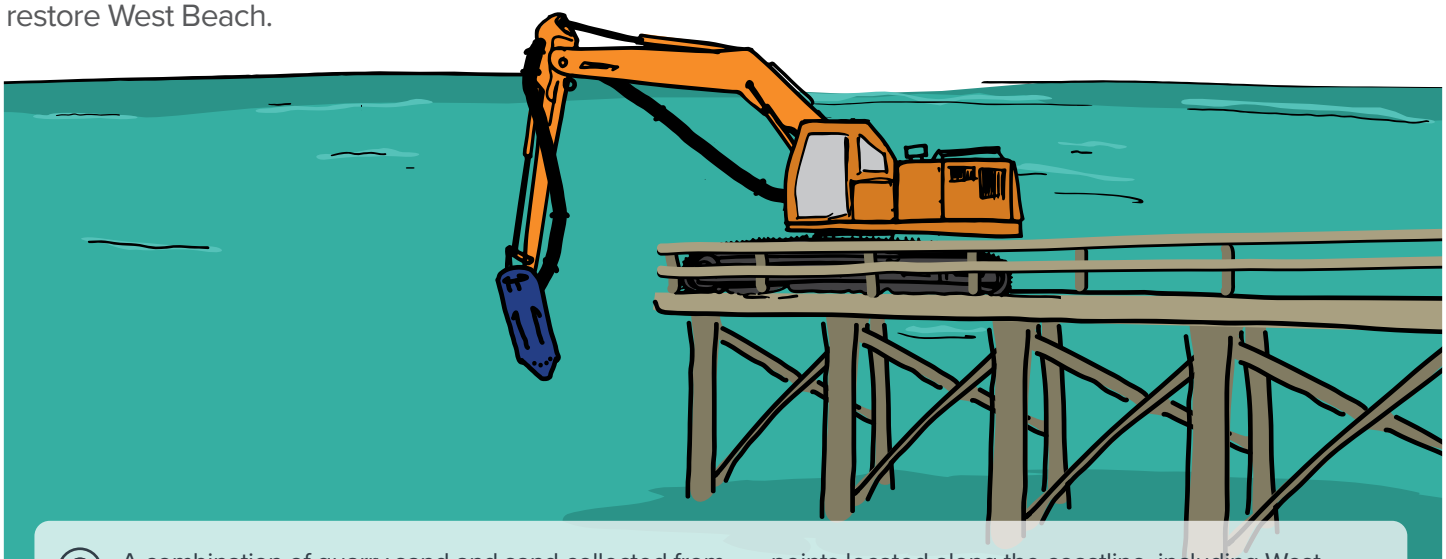
Work would be undertaken **yearly** over about **4 months**.

The estimated **20-year cost** for this method is **$140-155 million**.



Pipeline

Sand pumping uses underground pipelines to transfer sand and seawater from beaches where sand is building up to beaches in need of sand. Operating the pipeline would involve collecting sand from the beach or nearshore for 4 months at a time. Quarry sand would be delivered annually over the first 5-year period to restore West Beach.



A combination of quarry sand and sand collected from dedicated sand harvesting areas between Semaphore Park and Largs Bay would be used. For the pipeline component, sand intake points could be located at Largs Bay, Semaphore and Semaphore South.

The bulk of the pipeline sand would be primarily discharged at West Beach but additional discharge points located along the coastline, including West Beach (Rockingham St), Grange (The Esplanade), Tennyson (Moredun St) and West Lakes Shore (Mirani Ct), would allow sand to be delivered elsewhere as required. Quarry sand would be sourced from land-based quarries and delivered to West Beach using trucks accessing the beach via the Adelaide Sailing Club.

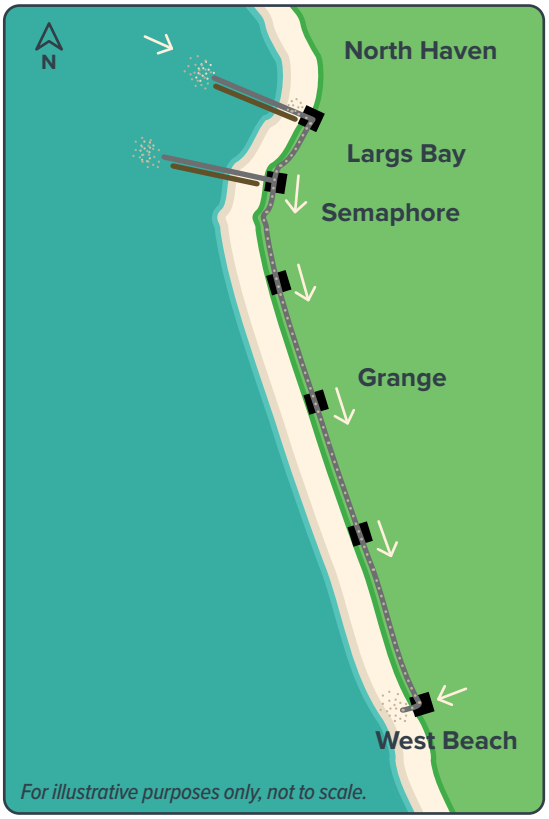
OPTION 2.2 Pipeline using dredge pump system on jetties

This option involves a **submersible pump** operating from a crane on the **Semaphore** or **Largs Bay jetties**. The dredge pump would mobilise the surrounding seabed sand, which is then pumped into the pipeline system through a pipe along the jetty and under the beach (see illustration).

Delivery of a **small annual quantity** of **quarry sand** would be expected to take about **3 months each year** for the **first 5 years**. **Four jet pumps** would be installed on the **Semaphore** and **Largs Bay jetties**. Sand would be **collected adjacent/ under** the **Semaphore** and **Largs Bay jetties**.

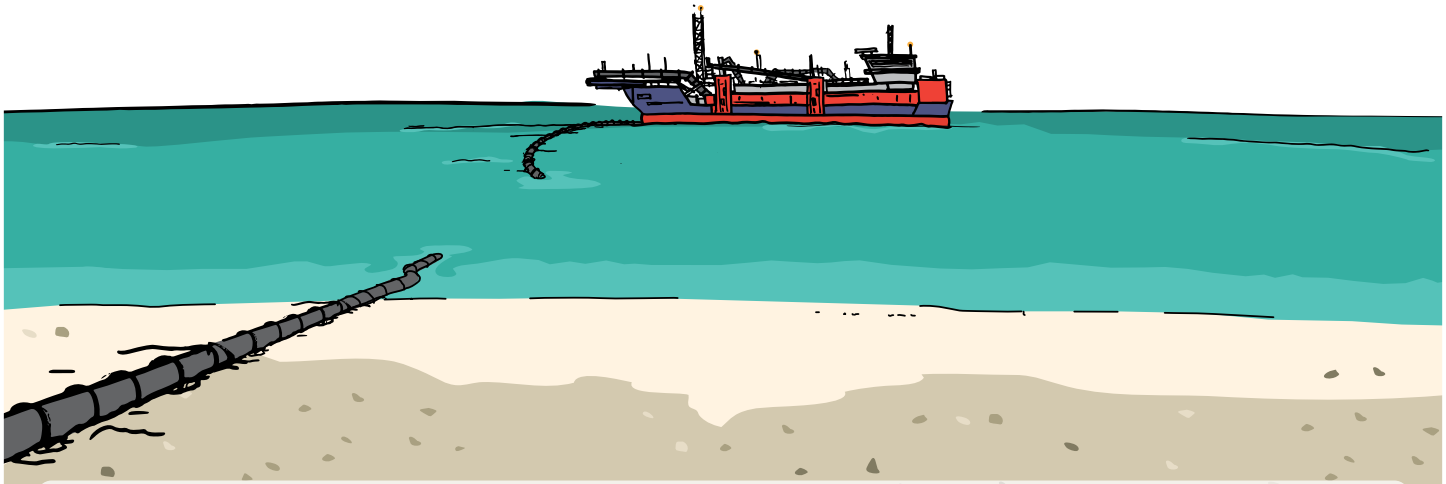
Work would be undertaken **yearly** over about **3-4 months.** Jetties would likely be closed to the public during collection.

The estimated **20-year cost** for this method is **$140-150 million**.



Pipeline

Sand pumping uses underground pipelines to transfer sand and seawater from beaches where sand is building up to beaches in need of sand. Operating the pipeline would involve collecting sand from the beach or nearshore for 4 months at a time. Quarry sand would be delivered annually over the first 5-year period to restore West Beach.



A combination of quarry sand and sand collected from dedicated sand harvesting areas between Semaphore Park and Largs Bay would be used. For the pipeline component, sand intake points could be located at Largs Bay, Semaphore and Semaphore South.

The bulk of the pipeline sand would be primarily discharged at West Beach but additional discharge points located along the coastline, including West Beach (Rockingham St), Grange (The Esplanade), Tennyson (Moredun St) and West Lakes Shore (Mirani Ct), would allow sand to be delivered elsewhere as required. Quarry sand would be sourced from land-based quarries and delivered to West Beach using trucks accessing the beach via the Adelaide Sailing Club.

OPTION 2.3 Pipeline using a temporary dredge

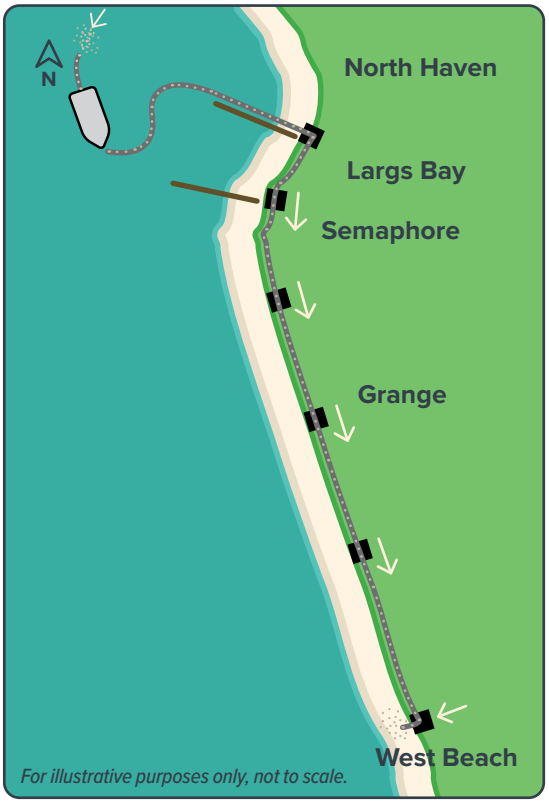
A **small sized dredge** would **collect sand** from the **near shore seabed** and **pumped directly** into the **pipeline** through the nearest **collection station**. A **mobile collection** method using a **dredge** provides flexibility on where sand can be sourced

Delivery of a **small annual quantity** of **quarry sand** would be expected to take about **3 months each year** for the **first 5 years**. **Sand** would be **collected** from the **seabed** using a **small dredge** between **Semaphore South** and **Largs Bay jetty**.

The dredge would collect sand from the seabed offshore near Largs Bay and Semaphore and pumped into the pipeline.

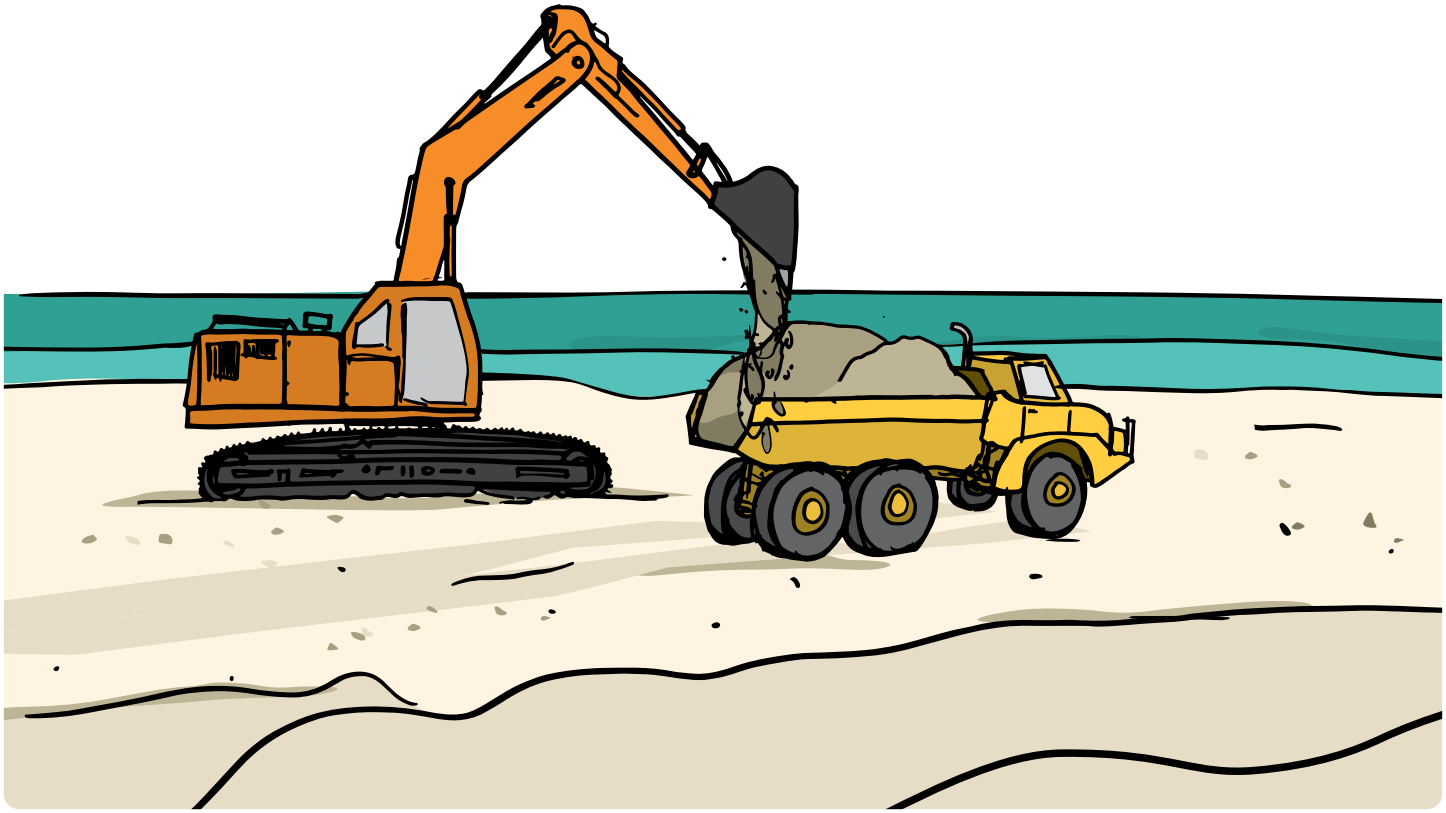
Work would be undertaken **yearly** over about **4 months**.

The estimated **20-year cost** for this method is **$140-155 million**.



Carting

Maintain current arrangement: Moving sand using trucks and machinery and external quarry sand.



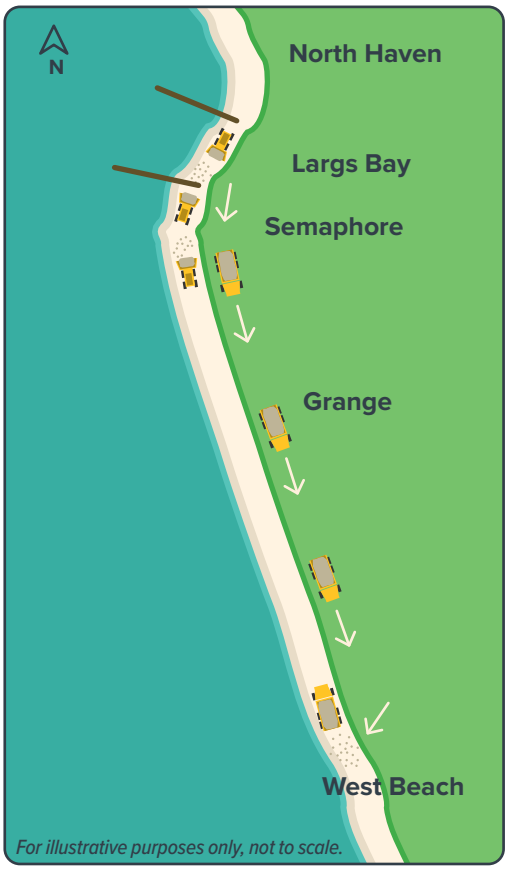
OPTION 3 Moving beach sand and quarry sand using trucks and machinery

Sand would be **collected** from the **beach** using an **excavator** and **front-end loader** and trucked to areas where sand is required. **External quarry sand** would be delivered using **trucks** on **public roads**. **Excavators** would be used to move the deposited sand to achieve the **desired beach profile**.

Equal amount of sand would be **collected onshore** from **Semaphore South** and **north of the Semaphore jetty** and delivered using **trucks** on **public roads** to **West Beach** or other beaches in need of sand. Sand sourced from **land-based quarries** would be delivered to West Beach using trucks accessing the beach via the **Adelaide Sailing Club**..

Sand delivery would happen **twice a year** over **2-3 months**.

The estimated **20-year cost** for this method is **$100-110 million**.



bluecoast
CONSULTING ENGINEERS

Cover note

To	Adelaide Beach Management Review Independent Advisory Panel (C/- DEW)
From	Bluecoast Consulting Engineers (Bluecoast)
Reference	CoverNote_DraftShortlistedOptions_R1.00
Date	20 September 2023
Subject	**Draft technical information on the shortlisted options**

Bluecoast were commissioned in December 2022 by the Government of South Australia's Department for Environment and Water (DEW) on behalf of the Adelaide Beach Management Review Independent Advisory Panel to undertake an independent scientific review of coastal management approaches along Adelaide's metropolitan beaches. As part of this scientific review, we have developed a draft shortlist of coastal management options for the Panel to seek feedback on community sentiment. For each shortlisted management option, the following draft technical information has been produced: a description, conceptual layout and a life-cycle cost estimate over a 20-year period.

As part of the consultation on the Adelaide Beach Management Review, Bluecoast's draft information on the shortlisted options was supplied to prepare community engagement material posted on the **yourSAy** website on Monday 18 September 2023. It is understood that further information on the shortlisted options, in addition to the community engagement material, was requested by members of the community to inform their feedback on the consultation. In response, Bluecoast was requested to supply the draft technical information on the shortlisted options in a format that could be published on the **yourSAy** website.

The draft technical information on the shortlisted options exists as a chapter in our report for the scientific review. This draft report is not due to be completed until mid-October 2023. To provide a timely response to the request for additional technical details, we have extracted the relevant sections from our working draft report and attached them to this cover note (see Attachment 1). In providing this draft information it is noted that:

- The draft information is considered preliminary in nature and subject to change. Other sections of our review report are yet to be finalised meaning any changes in other parts of the review could lead to changes to the technical details in the draft shortlisted options.
- The extracted draft information on the shortlisted options is provided without the context set out in other sections of our review report. For example, the sand management quantities adopted for the shortlisted options are an outcome of our sand budget analysis, being the scientific basis for these values. Direct references are also made to other sections of the review report.

It is further noted that a stakeholder workshop will be held on the 27 September 2023. Bluecoast representatives will be in attendance with additional details presented and time allocated for questions.

List of attachments:

Attachment 1: Preliminary draft technical information on shortlisted option extracted from the review report.

bluecoast
CONSULTING ENGINEERS

Attachment 1

6. Shortlisted management options

6.1 Introduction

Following on from the coarse filtering of the longlist of options for the northern management area[1], this section describes the shortlisted options. The shortlist consists of the four standalone options as well as the two pipeline sub-options. Each shortlist option has been developed to allow a description, conceptual layout, life-cycle cost estimate and comparative performance assessment, all of which are presented in this section.

Consistent with the early design stage, relatively simple methods were used to develop the shortlisted options. Methods included reviewing available literature, data and precedent projects which were used to inform selected configurations / strategies for each of the shortlisted options. In general, conservative assumptions and approaches have been adopted for the preliminary design of the main elements. More thorough approaches should be used during later design phases to better resolve and optimise the preferred option(s). Option A1 (backpassing pipeline) was an exception. Having been subject to detailed design, environmental assessment and construction tendering it had a highly resolved design available for reference.

Details of the life cycle cost estimates are provided in **Appendix C**. While life-cycle costs have been estimated no further economic appraisal, such as a cost-benefit analysis, has been completed.

The comparative assessment considers the relative performance of each option against specific assessment criteria which align with the goals of the Adelaide beach management review i.e.,

1. maximise the amount of sand on beaches
2. minimise disruption for all communities
3. avoid environmental harm.

The evaluation approach and results of this comparative technical assessment are provided in Section 6.7. For context, the shortlisted options:

- Are compared to a basecase, which assumes a continuation of the status quo.
- Aim to restore the sandy buffer at West Beach by adding the adopted 550,000m^3 of sand in the short term along with an additional sand top-up requirement of 90,000m^3/year. This sandy buffer at West Beach relates to review goal number one with quantities based on the findings of our sand budget of Adelaide's beaches (see Section 4.5).

It is important to note that implicit within the adopted basecase and shortlisted options is the assumption that the coastal processes driving the need for on-going sand management activities will continue.

6.2 Basecase CONSULTATION OPTION 3

A business-as-usual basecase was assumed for the comparator as part of the shortlist evaluation. The basecase for the northern management area was assumed based on actual beach management activities over the past three years (i.e., 2020 to 2022), see Figure 26 and Table 13. As such, the basecase includes ongoing implementation of sand carting at a rate of 130,000m^3/year from either internal (i.e., from beaches within the management area) or from external (i.e., quarries) sand sources. It is further

[1] The northern management area extents between West Beach (north of West Beach Boat Ramp) to North Haven Beach (southern Outer Harbour breakwater).

PRELIMINARY DRAFT - FOR DISCUSSION PURPOSES ONLY

assumed that the nature of future sand management interventions (i.e., sand volumes, sand sources and sand placement locations) would be like those that occurred between 2020 and 2022 (3 years).

The key elements of the adopted basecase are presented in Table 14 and Figure 27.

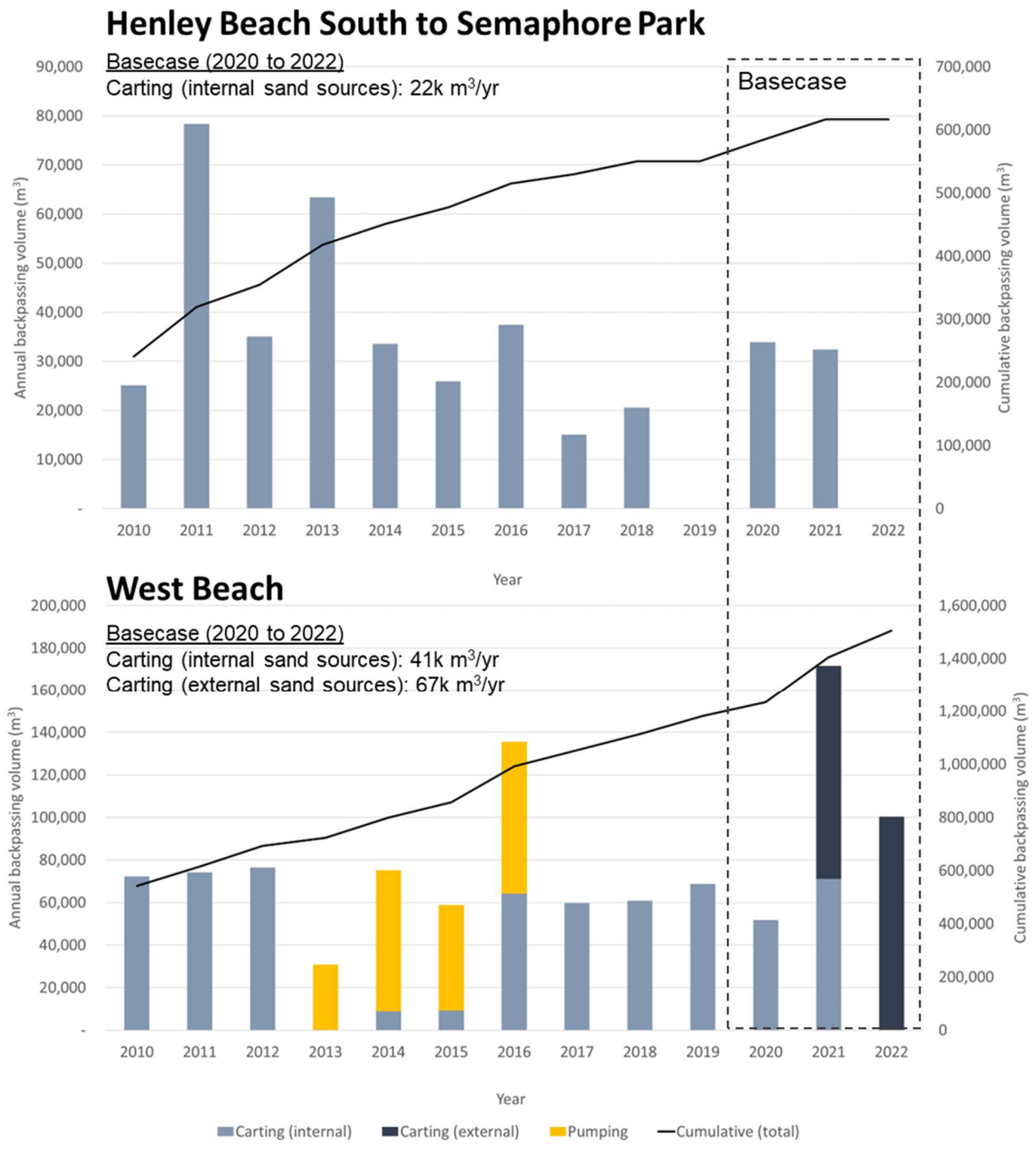


Figure 26: Existing sand management activities and adopted basecase period.

PRELIMINARY DRAFT - FOR DISCUSSION PURPOSES ONLY

bluecoast
CONSULTING ENGINEERS

Table 13: Sand management activities over adopted basecase period between 2020 to 2022.

Activity	Annual average sand volume (m^3/yr)	Sand source	Placement location	Comment
Sand carting	41,000	Torrens Outlet Semaphore breakwater Semaphore jetty	West Beach	Typically undertaken as annual campaign over two months
	67,000	Quarry (external source)	West Beach	Typically undertaken as two campaigns each year (two to three months per campaign)
	22,000	Torrens Outlet Semaphore breakwater	West Beach Semaphore Park	Typically undertaken as annual campaign over two months
Sand pumping	-	-	-	No pumping undertaken within management area

Table 14: Description of the adopted basecase (sand carting).

Design parameter	Description
Concept and rationale	The basecase involves a continuation of current beach management practices in the northern management area. A continuation of these practices will, over time restore and maintaining the sandy buffer at West Beach through regularly importing sand to the southern (updrift) end of the system. Under the 'keep sand moving' approach (see Section 5.3), the practices will restore and maintain the supply of sand to the West Beach or any other sediment compartment in the northern management area that requires nourishment. For this review, this has been assumed to involve: • Backpass sand south by using trucks from suitable downdrift areas where sand accretes to updrift areas where coastal erosion is occurring. • Importing sand using trucks from external (quarries) sources due to the limited amount of sustainably accessible sand on the northern beaches and to reduce associated disruption to the public along the northern areas. • Minor sand management activities within management area including small scale sand transfer via beach carting from adjacent deposition areas and dune rebuilding (not further described herein).
Sand carting strategy	Sand placements are undertaken annually over two to three campaigns, each typically of two-months duration, in winter each year. A total annual volume of 130,000m^3, comprising 65,000m^3 (50% of total) extracted from within the management area (internal sources) and 65,000m^3 (50% of total) delivered from quarries (external sources), which is based on a continuation of the status quo.

PRELIMINARY DRAFT - FOR DISCUSSION PURPOSES ONLY

bluecoast
CONSULTING ENGINEERS

Design parameter	Description
	Adopted daily sand transfer rates: • from northern beaches to West Beach: 1,500m^3/day (or 86 x truck loads per day) • from the quarries to West Beach: 1,000m^3 (or 58 x truck loads per day) Based on target placement volumes this requires around: • 3,727 x truck loads each year from the northern beaches (44 days) • 3,727 x truck loads each year from quarries (65 days)
Operational plant and equipment	Sand harvesting (from downdrift beaches) • 1 x tractor with landplane; and/or • 1 x excavator Sand loading • 2 x excavators + 1 x conveyor (if required to transport under Semaphore Jetty) • 1x loader/ excavator • 1 to 2 x dump trucks (to/from temporary stockpiles) • Road transport • 10 to 15 x road trucks (6 axles semitrailers carrying 25 to 29t of sand per load) Re-loading of sand from road truck onto dump trucks at deposition area • 1x 30t excavator • 2 to 4 x dump trucks Shaping of sand placements • 1 x 36t excavator • 1 x bulldozer **Note:** It is assumed suitable beach access ramps are in place and maintained (not costed as part of basecase). Most of these details are based on records of actual sand carting operations supplied to Bluecoast. Where details were missing, aerial photographs were used to supplement the records else assumptions were made.
Implementation	Operations during sand backpassing campaign (refer to Figure 27 for depiction of activities A, B, C1 etc): • Mobilisation (and demobilisation): mobilisation of earth moving equipment and site establishment at beach access points. Signage and traffic management only in place during works. Beach access and beach car parking areas are available to beachgoers and private vehicles without temporal restrictions during works. • Sand harvesting: begins approximately 4 hours to 1 day prior to planned carting. This includes: o A – (i) Tractor with landplane (scraper) and/or excavator collects sand within a designated beach strip between the lowest tide level and the base of the dune, with the length of the beach area dependent on the desired quantity of sand. Harvesting depth varies within a range of 300mm to 1,000mm. (ii) Sand is moved to temporary stockpiles at sand

PRELIMINARY DRAFT - FOR DISCUSSION PURPOSES ONLY

bluecoast
CONSULTING ENGINEERS

Design parameter	Description
	harvesting area either directly by landplane or by using dump trucks (loaded by excavator). ○ B – (i) If harvesting sand north of Semaphore Jetty, an excavator is used to load sand from the northern temporary stockpile onto a conveyor to transfer sand under the jetty where it is reloaded onto dump trucks for transfer to temporary stockpile at Point Malcom (Semaphore Park) or directly carted to the Semaphore Park placement area (ii) for further transportation via road, dozer and excavator/loader are used to load road trucks. • Transportation: ○ C1 – For sand transfer to Semaphore Park placement area dump trucks drive along beach. ○ C2 – For sand transfer to West Beach, this includes (i) road trucks access the beach ramp at Point Malcom (ii) once loaded they haul the sand via public roads and unload into temporary stockpile area at the beach end of Henley Sailing club and/or Adelaide Sailing Club access ramps at West Beach (iii) reload sand from temporary stockpile onto dump trucks using excavator for transport to final placement area (D1). • Sand placement (D2): (i) Dump trucks distribute sand along upper beach within sand placement area, (ii) excavators and/or dozers used to shape and adjust deposited sand to achieve the desired contours and profiles. • Works are undertaken around the weather and tides with operating hours for beach works between 7:00am and 7:00pm, Monday to Friday. <u>Beach operations during campaign importing sand from quarries:</u> • As above, commencing with road trucks delivering sand at West Beach (see C2).

PRELIMINARY DRAFT - FOR DISCUSSION PURPOSES ONLY

bluecoast
CONSULTING ENGINEERS

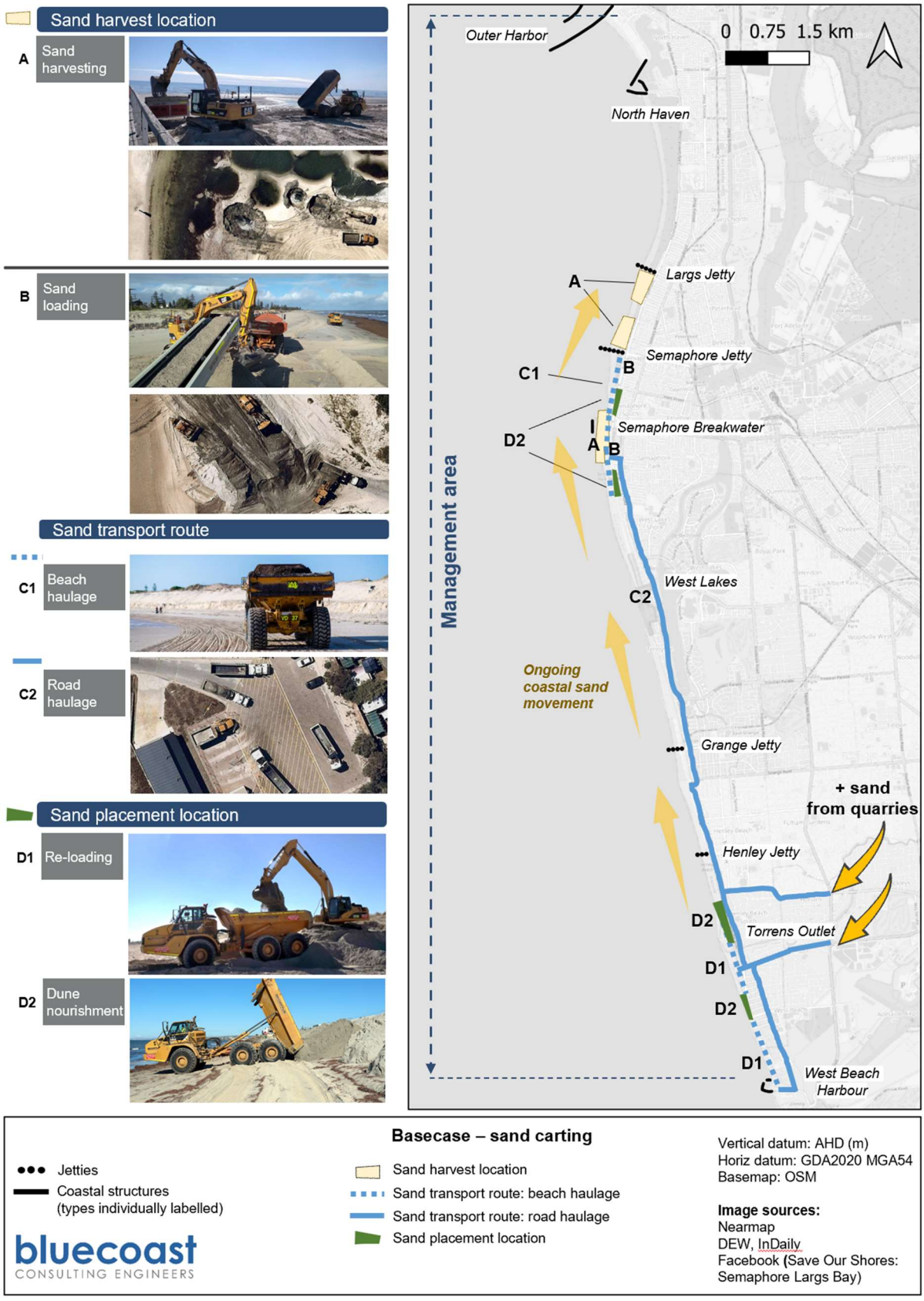


Figure 27: Conceptual layout of recent sand carting activities (basecase).

PRELIMINARY DRAFT - FOR DISCUSSION PURPOSES ONLY

bluecoast
CONSULTING ENGINEERS

6.3 Option A1 Backpassing pipeline

Table 15 outlines key details and describes this backpassing pipeline option (Option A1). Figure 22 presents the conceptual design layout of the option.

Option A1 was developed as part of the *Securing the Future of our coastline project*. Technical details have been taken from 'for approvals' documentation of the proposed backpass pipeline (McConnel Dowell, 2022; SMEC, 2022). Operational aspects are based, in a large part, on the experience from the existing Glenelg to Brighton pipeline to the south of the management area. This southern sand backpassing pipeline began operations in 2013.

Guided by this review's goals, potential opportunities to optimise the design of the proposed backpass system have been identified and could be explored should this option be progressed. Two alternative sub-options for the sand harvesting and intake procedure of the backpass system are described in Section 6.3.1.

Table 15: Description of the backpassing pipeline option (Option A1).

Design parameter	Description
Concept and rationale	This option involves initial nourishment to restore the sandy buffer at West Beach followed by regular and on-going sand top-ups to maintain the buffer. Under the 'keep sand moving' approach (see Section 5.3), it seeks to restore and maintain the supply of sand to the West Beach or any other sediment compartment in the northern management area that requires nourishment. Because the northern management area has a net positive sand budget (i.e., the overall system does not need more sand), sand would be collected from the northern extent of the management area and back passed to the southern beaches. For this review, and for both initial and on-going nourishment exercises, this has been assumed to involve: • Initial (once-off) restorative nourishment at West Beach via sand carting from quarries (see 'C1' to 'D2' basecase elements in Section 6.2 – not further described here). Alternatively, this could be achieved via dredging as described in Section 6.4 (Option A3). Successfully adopting this alternative for the restorative volumes by dredging would result in an estimated $21 million in savings over carting of quarry sand. Moreover, it has been assumed that the backpassing pipeline could not be used for the purpose of supplying this restorative volume. This is because it would exceed the volumes that can be sustainably harvested from the northern beaches (Salients, 2021 and Water Technologies, 2020). • Installation and operation of permanent infrastructure including pumping stations and underground pipelines to transfer a sand slurry (i.e., sand and seawater) from beaches where sand is building up, to beaches where sand is eroding. The backpassing pipeline would be connected to the existing pipeline at West Beach (south of Torrens Outlet). The new backpassing system would allow sand collected from dedicated sand harvesting areas using earthmoving equipment between Semaphore Park and Largs Bay to be pumped and discharged as a sand slurry onto the upper beach at fixed pipe outlets throughout the northern management area. Discharged sand would build up the local sand buffer as well as feed sand into the net northward longshore sand transport system, supplying sand to downdrift beaches. When discharged, the sand settles out from the slurry forming a low, wide mound with excess water returning to the sea.

PRELIMINARY DRAFT - FOR DISCUSSION PURPOSES ONLY

bluecoast
CONSULTING ENGINEERS

Design parameter	Description
Sand backpassing strategy	As per the other shortlisted options, the sand backpassing strategy is based on achieving: • Initial nourishment volume of 550,000m^3 via sand carting from quarries delivered to West Beach over first five years (commencing 2024). • Sand backpassing via pipeline is undertaken annually over a single campaign of four-month duration in winter each year. Total annual target backpassing volume is 90,000m^3/year with average daily backpass sand transfer rate based on existing sand pumping operations of 1,250m^3/day. For this review, it was assumed all backpass sand is delivered to West Beach.
Permanent and operational backpass infrastructure	<u>Permanent infrastructure</u> • 3 x sand intake locations where mobile beach-based sand collection equipment can supply sand to the pipeline at either: ○ Semaphore South ○ Semaphore ○ Largs Bay • 13.2km of underground (buried) sand backpassing pipeline (from Largs Bay jetty to south of Torrens Inlet and then West Beach) • 7 x permanent electrically powered slurry pump stations and associated components along the foreshore (largely buried) at: ○ West Beach (Henley Beach Road) ○ Grange (Terminus Street) ○ Tennyson (Moredun Street) ○ West Lakes Shore (Mirani Court) ○ Semaphore Park (Bower Road) ○ Semaphore (Hall Street) ○ Largs Bay (Everard Street) • 4 x fixed pipe outlets (discharge points) to discharge slurry at the toe of dune/seawall at: ○ West Beach (Rockingham Street) ○ Grange (The Esplanade) ○ Tennyson (Moredun Street) ○ West Lakes Shore (Mirani Court) • 1 x seawater intake pump station at West Lakes inlet (off Trimmer Parade) • 8.5km of seawater supply pipeline from seawater intake pump station to sand intake locations. <u>Operational elements</u> • Sand harvesting area/ sand intakes: ○ 1 x tractor with land plane (scraper) for sand harvesting ○ 1 x 36t excavator for loading

PRELIMINARY DRAFT - FOR DISCUSSION PURPOSES ONLY

bluecoast
CONSULTING ENGINEERS

<table>
<tr><th>Design parameter</th><th>Description</th></tr>
<tr><td></td><td>

1 x mobile Sand Collection Unit (SCU) consisting of a hopper, conveyor belt, screening trommel and mobile slurry pump connected to one of the three permanent pipeline intakes

• Sand discharge points:

temporary pipeline sections/ diffusers (where required)
5t excavator and/or Hiab crane

</td></tr>
<tr><td>Backpass system capacity</td><td>
<table>
<tr><th>Activity</th><th>Value</th></tr>
<tr><td>Sand placement</td><td>• 1,500m^3/day peak sand transfer rate</td></tr>
<tr><td>Sand collection[1]</td><td>• 203m^3/hr sand transfer rate
• 2m^3/hr seagrass wrack removal rate</td></tr>
<tr><td>Sand pumping[1]</td><td>• 200m^3/hr sand transfer rate, with
• 235l/s slurry flow rate, and
• 1.26Sg slurry density</td></tr>
</table>
Note: [1] Assumes sand D50 of 0.26mm (conservative design value, refer to Appendix A) and sand dry bulk density of 1.62 t/m^3. Reduced system capacity would be expected for coarser material.
</td></tr>
<tr><td>Backpass system implementation</td><td>
<u>Site investigations, project planning and environmental assessments</u>
The northern pipeline has been approved for construction. It has therefore been assumed this project phase could be completed within 6-months in 2024. During which time on-going sand carting from quarries has been assumed to continue, including commencing delivery of initial restoring nourishment volume (i.e., on top of the common 90,000m^3/yr sand top-up requirement). The sand carting elements and associated disruption to beach access and local roads for this activity are described in the basecase (see Section 6.2).
<u>Construction (approx. 1-year duration, assumed by mid-2025)</u>

Permanent pipeline installation: Most of the slurry pipeline and seawater supply pipeline (from the seawater water intake station to the three sand intake sites) would be installed underground by trenching.
Booster pump stations: Each pump station is a permanent underground concrete structure founded on screw piles (approximate footprint 15m x 7m for single pump station and 15m x 10m for double pump station). Aboveground vent stacks for air circulation and cooling (approximately 4m tall and 2m x 2m above ground footprint). Each pump station requires services including mains water supply, electrical and communications.
Water intake pump station: Above-ground pump house constructed on an existing carpark. Construction includes water supply pipeline as well as electrical and communications services.

</td></tr>
</table>

PRELIMINARY DRAFT - FOR DISCUSSION PURPOSES ONLY

bluecoast
CONSULTING ENGINEERS

Design parameter	Description
	Operation (annual 4-month campaign, from mid-2025) • Mobilisation (and demobilisation): mobilisation of earth moving equipment, SCU and site establishment at selected sand harvesting site including demarcation of laydown area (approximately 50m x 50m). • Sand collection: (i) Tractor with landplane collects sand from beach several hundred metres either side to stockpile immediately adjacent to the SCU. (ii) One 36t excavator is used to directly load sand from stockpile into the hopper of the SCU. (iii) Dozer and excavator are used to load dump trucks for redistribution of screened seagrass wrack. • Slurry discharge: ○ Demarcation and installation of signage on beach at selected discharge site(s) and pedestrian management for beach user safety (e.g., redirection or access closure). Typical work area a 20 to 80m stretch of beach (depending on backpassing volume) extending seaward into the water. ○ Ground personnel manage discharge flow where required including making safe of the discharge area at end of pumping event using 5t excavator (where required) ○ Installation/ removal of temporary pipeline sections (where required) and diffusers to connect to permanent pipeline outlets. 5t excavator or Hiab crane is used to handle temporary pipework. • Sand backpass operation Monday to Friday between 7.30am and 5.00pm and avoiding summer and school holidays when beach usage is high.

PRELIMINARY DRAFT - FOR DISCUSSION PURPOSES ONLY

bluecoast
CONSULTING ENGINEERS

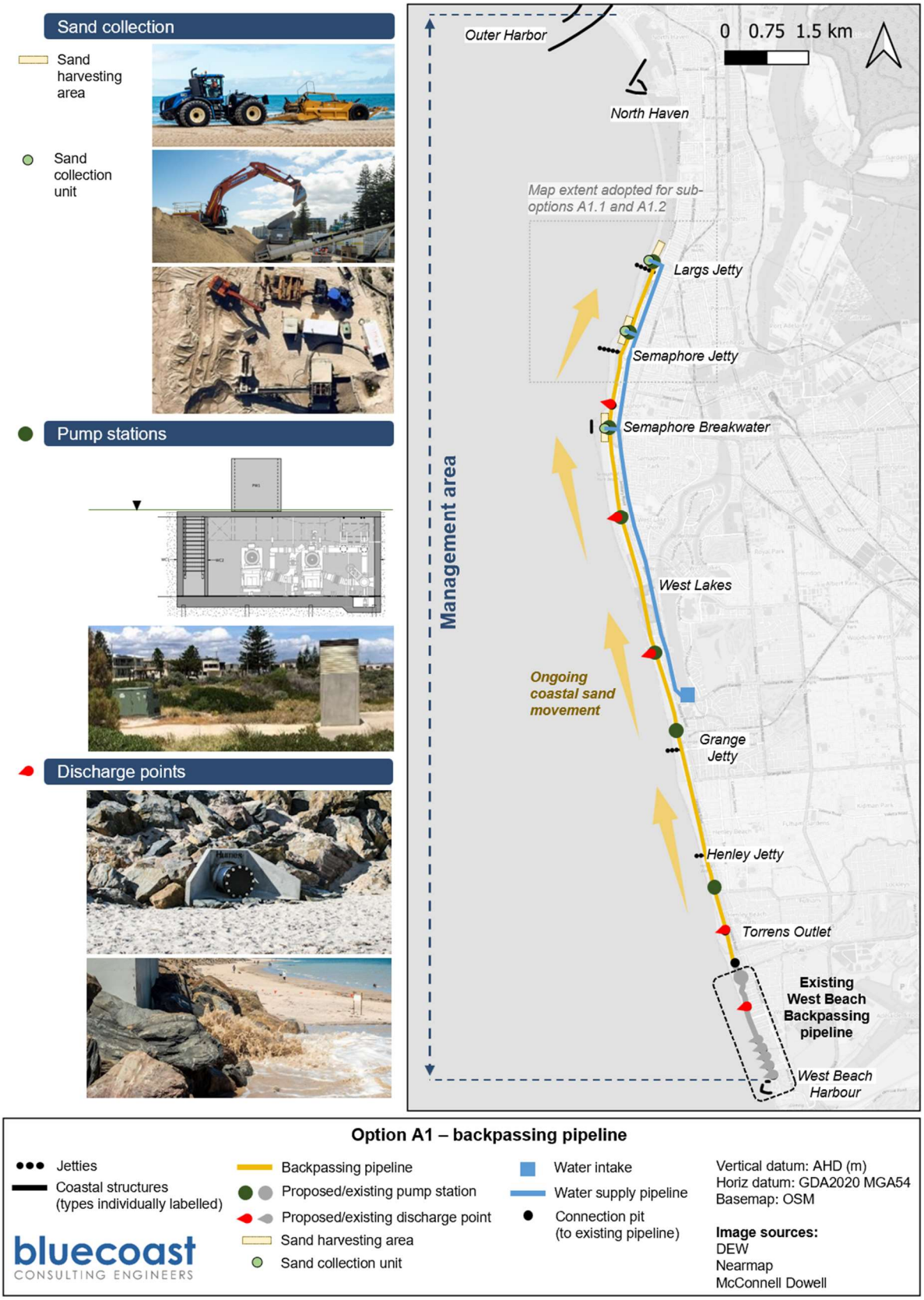


Figure 28: Conceptual design layout of the backpassing pipeline option (Option A1).

PRELIMINARY DRAFT - FOR DISCUSSION PURPOSES ONLY

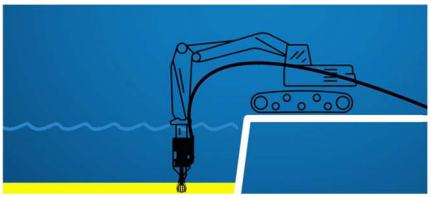
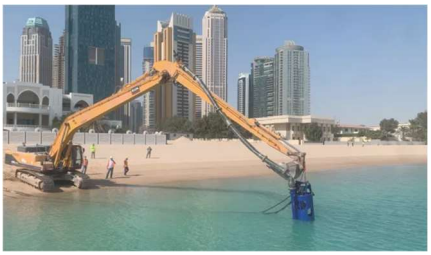
bluecoast
CONSULTING ENGINEERS

6.3.1 Sand intake sub-options (A1.1 and A1.2)

Two sub-options for the sand harvesting and intake of sand into the backpassing system are described in Table 16. Each of the two sub-options (A1.1 and A1.2) would substitute the beach-based sand harvesting elements described for Option A1 in Table 15. Should the backpassing pipeline option (A1) be progressed, the two alternative sand harvesting methods (A1.1 and A1.2) could be considered for further investigation.

If successful, nearshore sand intakes would remove the need for sand harvesting from the visible (subaerial) beach. This would be expected to significantly reduce the associated disruption to coastal communities and beach and foreshore users.

Table 16: Sub-option A1.1 with alternative sand intakes for proposed backpassing pipeline.

Sub-option	Description and value opportunity
Jetty and shoreline based sand intake(s) (Option A1.1)  *Image source: Damen*  *Image source: Damen*	Key elements • Single submersible (DOP) dredge pump attached on Hiab crane or long-reach excavator that can be lowered from existing Semaphore and/or Largs jetties. DOP pumps are powered by a hydraulic power pack attached to crane/excavator and are designed to operate underwater with minimal land-based ancillary equipment. The pumps fluidise surrounding sand at the seabed which will provide a source of sand for the backpassing system. Vegetation cutter blades are used on DOP pump to avoid blockage by seagrass wrack. • Temporary slurry pipeline installed along jetty (or floated across surfzone) and buried under beach to transfer fluidised sand as a slurry to the nearest backpassing pipeline pump station, from which would be as per option A1 above. • Nearest pump station includes hopper, screening trommel and additional seawater supply to allow adjusting slurry density for pumping through backpass pipeline. • Designed to match daily target sand transfer volume of 1,250m^3/day. Possible increased sand transfer rate matching peak backpass system capacity of 200m^3/hr, or around 1,600m^3/day. This could reduce the annual campaign duration from four to three months. Alternatively, fixed or semi-mobile jet pumps operating from the existing jetties could be considered. Further assessment required to determine number, location and spacing of jet pumps if fixed. Value opportunity • Use of existing jetties to access sand in nearshore seaward from seagrass wrack deposition areas. • Reduces heavy machinery and ancillary equipment on beach during operations.

PRELIMINARY DRAFT - FOR DISCUSSION PURPOSES ONLY

bluecoast
CONSULTING ENGINEERS

Sub-option	Description and value opportunity
Nearshore mobile sand intake(s) (Option A1.2)  *Image source: Maritime Constructions*	Key elements • 1 x small to medium sized cutter suction dredge (or similar) to collect sand from the nearshore area in locations where sand accretes (e.g., between Semaphore South and Largs jetty). Alternatively, a custom designed barge could be used with an excavator or crane mounted (DOP) pump in nearshore locations. • Temporary pipeline to feed slurry directly to nearest pump station of the backpassing system. Value opportunity • Mobile equipment provides flexibility where sand can be extracted. • Reduces heavy machinery on beach during operations. • Possible increased sand transfer rate matching peak backpass system capacity of 200m^3/hr, or around 1,600m^3/day. This could reduce the annual campaign duration from four to three months.

PRELIMINARY DRAFT - FOR DISCUSSION PURPOSES ONLY



Figure 29: Conceptual design layout for sand intake sub-options (Option 1.1 and Option 1.2).

PRELIMINARY DRAFT - FOR DISCUSSION PURPOSES ONLY

bluecoast
CONSULTING ENGINEERS

6.4 Option A3 Backpassing using a dredge

Table 17 outlines key details and describes this backpassing using a dredge option (Option A3). Figure 30 presents the conceptual design layout of the option.

Table 17: Description of the backpassing using a dredger option (Option A3).

Design parameter	Description
Concept and rationale	This option involves initial nourishment to restore the sandy buffer at West Beach followed by regular and on-going sand top-ups to maintain the buffer. Under the 'keep sand moving' approach (see Section 5.3), it seeks to restore and maintain the supply of sand to the West Beach or any other sediment compartment in the northern management area that requires nourishment. Because the northern management area has a net positive sand budget (i.e., the overall system does not need more sand), sand would be collected from the northern extent of the management area, in depth accessible to suitable dredgers, and backpassed to the southern beaches. The option achieves this by using floating plant specifically designed to collect, transport and place marine sediments (i.e., dredgers). For this review, and for both initial and on-going nourishment exercises, this has been assumed to involve: • Contracting a small sized trailer suction hopper dredge (TSHD) that would be mobilised to site to perform each exercise. Based on our knowledge of the dredging industry there are suitable dredgers located on the east coast of Australia or New Zealand that could undertake the works. • Dredging would be undertaken to collect suitable sand from a borrow area (i.e., sand source) that has been identified just south and offshore of the southern Outer Harbour breakwater (see **Appendix A**). The dredged sand would be transported in the TSHD's hoppers to the placement site, primarily West Beach which is located 17.8km from the borrow area. • Nourishment sand would be placed at West Beach or other placement site using a modified version of the 'pump ashore' method which would place the sand in the surf zone rather than on the dry beach. Alternative placement methods including standard pump ashore, rainbowing and bottom dumping are available, these are described in **Appendix B**. The 1997 review of the management of Adelaide beaches investigated sand nourishment by dredging. That review investigated a different borrow area and therefore arrived at a different and more costly dredging methodology. However, the report did note that sand nourishment using a method like that proposed herein and as used for Brighton would be significantly cheaper. At the time sand carting was an attractive approach with transport routes and beach access likely to be less restrictive than today. Use of nearshore dredging and nearshore sand placement removes the need for any trucks or other equipment on beaches or on local roads, minimising disruption to coastal communities and beach and foreshore users.
Nourishment strategy	<u>Nourishment frequency, quantities and durations</u> Based on the sand budget outcomes (see Section 4.5) with consideration of cost and dredging production estimates, this option is assumed to consist of: • Initial (once-off) restorative nourishment of 820,000m^3 delivered to West Beach using a small (1,400m^3 hopper capacity) TSHD over a 15-week works period. • On-going sand top-ups of 360,000m^3 every 4-years delivered to West Beach using a small TSHD over a 7-week works period.

PRELIMINARY DRAFT - FOR DISCUSSION PURPOSES ONLY

Design parameter	Description
	Alternative scenarios should be explored in the case this option is progressed. Given the dynamic nature of Adelaide's beaches as well as dredger availability, a degree of flexibility is expected in the nourishment strategy. Sand source, dredging and dredging cycles All sand would be sourced from the nearshore of the northern management area from the 'Offshore of Largs Bay' borrow area discussed in Table 24. When undertaking nourishment works the TSHD will repeat cycles involving loading sand from the borrow area, sail loaded to the placement area(s), unload using the adopted sand placement method and return to the borrow area for loading. A standard sand dredging method will be used with more detailed provided in Table 24. Placement method and areas A modified pump ashore placement method (see Table 32 in **Appendix B**) is proposed. Under this proposed placement method, a floating pipeline would be established in the nearshore at the placement area. The floating pipeline would run from a nearshore mooring (also established for the works) to a floating outlet just seaward of the surfzone (around -2 to -4m AHD). On approach to the placement area, the dredger would manoeuvre to the mooring. Once moored, the floating pipeline will run from the bow of the TSHD to the outlet location. A small support vessel will pass the connecting lines used to pull the male part of the ball joint from the floating line into bow of the vessel to make the connection. The time required to undertake this operation is usually about 15 minutes (25 minutes has been allowed in production estimates). The sand released from the floating pipeline would be placed in specifically designed nearshore mounds. For this assessment, the local bathymetry at West Beach has been checked to confirm the placement concept. For example, 100,000m^3 could be placed in five (5) mounds each of roughly 20,000m^3 by situating the outlet at approximately the -3m AHD depth contour, around 100 to 150m seaward from the shoreline (0m AHD contour). The spacing between mounds would be 150m, resulting in nourishment of around 900m of shoreline. This approach would require moving the floating pipeline outlet a minimum five (5) times and has been depicted in Figure 30. To unload the sand material held in the hopper, a large quantity of water is required to re-fluidise the sand to enable it to be pumped. The water for this will be extracted from the adjacent waters via pumps on board the dredge. For cost estimates completed herein, all sand has been assumed to be delivered to West Beach. However, as shown on Figure 30, placement areas would be flexible and could be established along the northern management area as the need arises. Should this option be progressed, alternative placement methods, including traditional pump ashore, rainbowing and/or bottom dumping, should be further investigated.
Implementation	Site investigations, project planning and environmental assessments Investigations of the borrow area would be required to assess the resource and its suitability for beach nourishment. This would involve bathymetric and geophysical surveys, shallow (vibro-coring) and sediment sampling and analysis. Should suitability be confirmed then concept dredge and placement designs as well as environmental approvals, licences could be progressed. Environmental aspects at this borrow site are discussed in Table 24. Environmental impacts would require assessment and likely to require dredge plume modelling, ecological (seagrass) surveys and baseline monitoring (water quality and possibly noise). It has been assumed that this could be completed within a 12-month period (2024), during which time on-going sand carting from quarries has been assumed to continue.

PRELIMINARY DRAFT - FOR DISCUSSION PURPOSES ONLY

bluecoast
CONSULTING ENGINEERS

Design parameter	Description
	The sand carting elements and associated disruption to beach access and local roads for this activity are described in the basecase (see Section 6.2). Initial (once-off) restorative nourishment (approx. 15-week duration) • Nourishment works would be undertaken on a 24 hour by 7-days a week basis (subject to approval). • Virtually all nourishment works would be undertaken using floating plant with little effect on beach or foreshore access during the works. Swimmer safety would require access to be monitored during sand placement. • The proposed mooring and floating pipeline have been placed at a slightly deeper area off West Beach, which is away from the boat harbour such that navigational access to the harbour would not be restricted during the works. It is further noted that regular maintenance dredging (i.e., every few years) of these harbours, including the use of floating pipelines and nearshore material placements is undertaken already. • Nourishment works are likely to be undertaken in winter or autumn months to avoid impacts on seagrasses. • A range of environmental management activities, including turbidity monitoring and pre- and post-dredging seagrass surveys, will be required during the works. It is noted that recent capital dredging works to widen the Port Adelaide navigation channel adjacent to the identified borrow area removed over 1.5 M m^3 of material and did not adversely affect seagrasses (EPA, 2020). Ongoing sand top-ups (once every 4 years, with each campaign of just under 7-week duration) • As above but for a shorter duration due to relatively smaller target volume.

PRELIMINARY DRAFT - FOR DISCUSSION PURPOSES ONLY

bluecoast
CONSULTING ENGINEERS

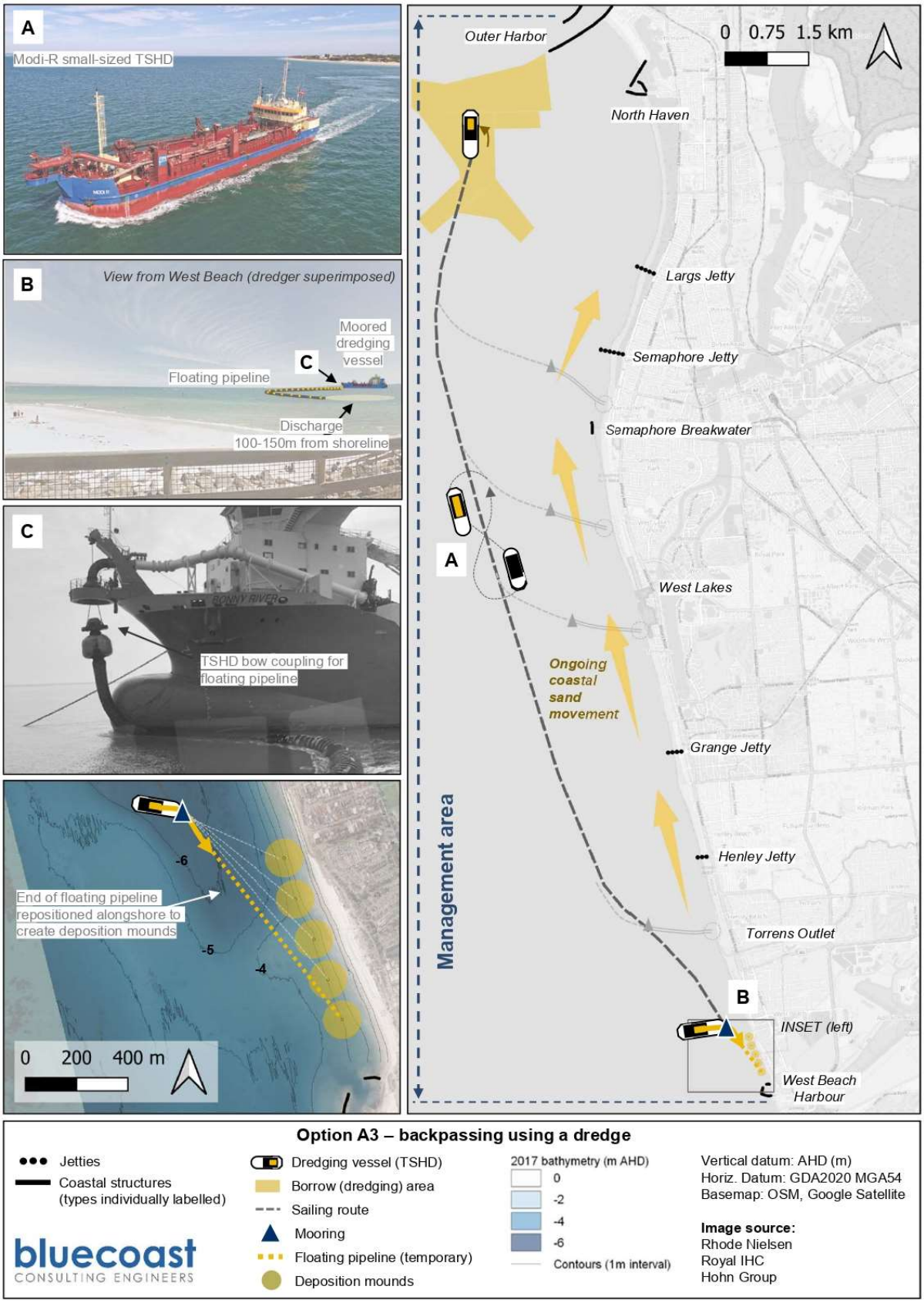


Figure 30: Conceptual design layout of the backpassing using a dredge (Option A3).

PRELIMINARY DRAFT - FOR DISCUSSION PURPOSES ONLY

bluecoast
CONSULTING ENGINEERS

6.5 Option B1 Mass nourishment

Table 18 outlines key details and describes this mass nourishment option (Option A3). Figure 31 presents the conceptual design layout of the option.

Table 18: Description of the mass nourishment option (Option B1).

Design parameter	Description
Concept and rationale	This option involves mass nourishment at West Beach which would be designed to place, in a single exercise, enough sand to provide a buffer over a 20-year period. Under the 'keep sand moving' approach (see Section 5.3), it seeks to restore and pre-nourish the supply of sand to the northern management area. The review assumes all sand would be placed at West Beach, the most updrift (southerly) beach in the management area. The option achieves this by using floating plant specifically designed to collect, transport and place marine sediments (i.e., dredgers). For this review, the mass nourishment at West Beach has been assumed to involve: • Contracting a medium sized trailer suction hopper dredge (TSHD) that would be mobilised from to site to perform the exercise. Based on our knowledge of the dredging industry, such a vessel would likely come from the international fleet and need to mobilise to site from another country. • Dredging would be undertaken to collect suitable sand from one or more borrow area(s) (i.e., sand source(s)) that have been identified offshore of Largs Bay, north of the Outer Harbour navigation channel (including the Section Bank) or from Port Stanvac (see **Appendix A**). The dredged sand would be transported in the TSHD's hoppers to the placement site, primarily West Beach which is located 17.8km from the borrow area. • Nourishment sand would be placed at West Beach or other placement site using a 'pump ashore' method. Alternative placement methods including modified pump ashore, rainbowing and bottom dumping are available. This review presents options that are early in the design development stage. There are other construction methodologies and/or sand sources that may be the focus after further investigations and design development. As with any beach nourishment project the final methodology would be delivered by the construction contractor.
Nourishment strategy	<u>Nourishment frequency, quantities and durations</u> Based on the sand budget outcomes (see Section 4.5) with consideration of cost and dredging production estimates, this option is assumed to consist of: • Mass nourishment of 2.35 M m^3 (million cubic metres) delivered to West Beach using a medium (6,000m^3 hopper capacity) TSHD over a 15-week works period. Alternative scenarios should be explored in the case this option is progressed. <u>Sand source, dredging and dredging cycles</u> Sand for mass nourishment could be efficiently sourced from several nearshore borrow areas, pending further investigations and approvals. Specifically, this review assumed that dredging to collect sand for mass nourishment could occur from borrow areas at: • Offshore of Largs Bay, detailed of which are discussed in Table 24 • Section Bank and surrounds, detailed of which are discussed in Table 26

PRELIMINARY DRAFT - FOR DISCUSSION PURPOSES ONLY

bluecoast
CONSULTING ENGINEERS

Design parameter	Description
	• Port Stanvac, detailed of which are discussed in Table 27. When undertaking nourishment works the TSHD would repeat cycles involving loading sand from the borrow area, sail loaded to the placement area(s), unload using the adopted sand placement method and return to the borrow area for loading. A standard sand dredging method would be used with more detailed provided in Table 24. Placement method and areas A standard pump ashore placement method (see Table 32 in **Appendix B**) is proposed. Under this proposed placement method, a floating pipeline would be established in the nearshore at the placement area. The floating pipeline would run from a nearshore mooring (also established for the works) to: • the subaerial (or dry) beach outlet to nourish the upper profile with earthmoving equipment required to redistribute the pumped sand as well as manage the pipeline and • a floating outlet just seaward of the surfzone (around -2 to -4m AHD) to nourish the surf zone. The coupling process for the dredger to the floating pipeline is like that described for Option A3 (see Table 17). If this option progressed, further consideration should be given to the need for burial or weighting of the pipeline to cross the surfzone. The sand released from the pipeline would be placed along the subaerial beach and within the surfzone to widen the full coastal profile. For this review, the local bathymetry at West Beach has been checked to confirm the placement concept. 2.35 M m^3 could be placed along a 2.2km stretch of shoreline, which would result in an average widening of the beach of around 100-125m. This approach has been depicted in Figure 31. For cost estimates completed herein, all sand has been assumed to be delivered to West Beach. However, additional placement areas could be established along the northern management area if needed. The sand placement design would need to consider impacts on Torrens Outlet linked to sand deposition. Should this option be progressed, alternative placement methods, including modified pump ashore, rainbowing and/or bottom dumping, should be further investigated.
Implementation	Site investigations, project planning and environmental assessments Similar to Option A3, investigations of the borrow area(s) would be required to assess the resource and its suitability for beach nourishment. This would involve bathymetric and geophysical surveys, shallow (vibro-coring) and sediment sampling and analysis. It is noted that these investigations have been recently completed at Port Stanvac with a 200,000 to 300,000m^3 sand resource confirmed. Should suitability be confirmed then concept dredge and placement designs as well as environmental approvals, licences could be progressed. Environmental aspects at the relevant borrow sites are discussed in **Appendix A**. Environmental impacts would require assessment and likely to require dredge plume modelling, ecological (seagrass) surveys and baseline monitoring (water quality and possibly noise). For mass nourishment it has been assumed that this could be completed within a 24-month period (i.e., mass nourishment delivered some time in 2026). During the planning period on-going sand carting from quarries has been assumed to continue. The sand carting elements and associated disruption to beach access and local roads for this activity are described in the basecase (see Section 6.2).

PRELIMINARY DRAFT - FOR DISCUSSION PURPOSES ONLY

bluecoast
CONSULTING ENGINEERS

Design parameter	Description
	Mass nourishment (approx. 15-week duration) • Nourishment works would be undertaken on a 24 hour by 7-days a week basis (subject to approval). • Nourishment works are assumed to occur using both pumping to the beach and surfzone. During these works beach and surfzone access would be restricted to all or part of the 2.2km placement area. • Navigation exclusions zones would be required at the dredging and placement sites, with the potential to restrict access to the West Beach boat harbour during part of or all of the placement works. • Nourishment works are likely to be undertaken in winter or autumn months to avoid impacts on seagrasses. • A range of environmental management activities, including turbidity monitoring and pre- and post-dredging seagrass surveys, will be required during the works. It is noted that recent capital dredging works to widen the Port Adelaide navigation channel adjacent to the identified borrow area removed over 1.5 M m^3 of material and did not adversely affect seagrasses (EPA, 2020).

PRELIMINARY DRAFT - FOR DISCUSSION PURPOSES ONLY

bluecoast
CONSULTING ENGINEERS

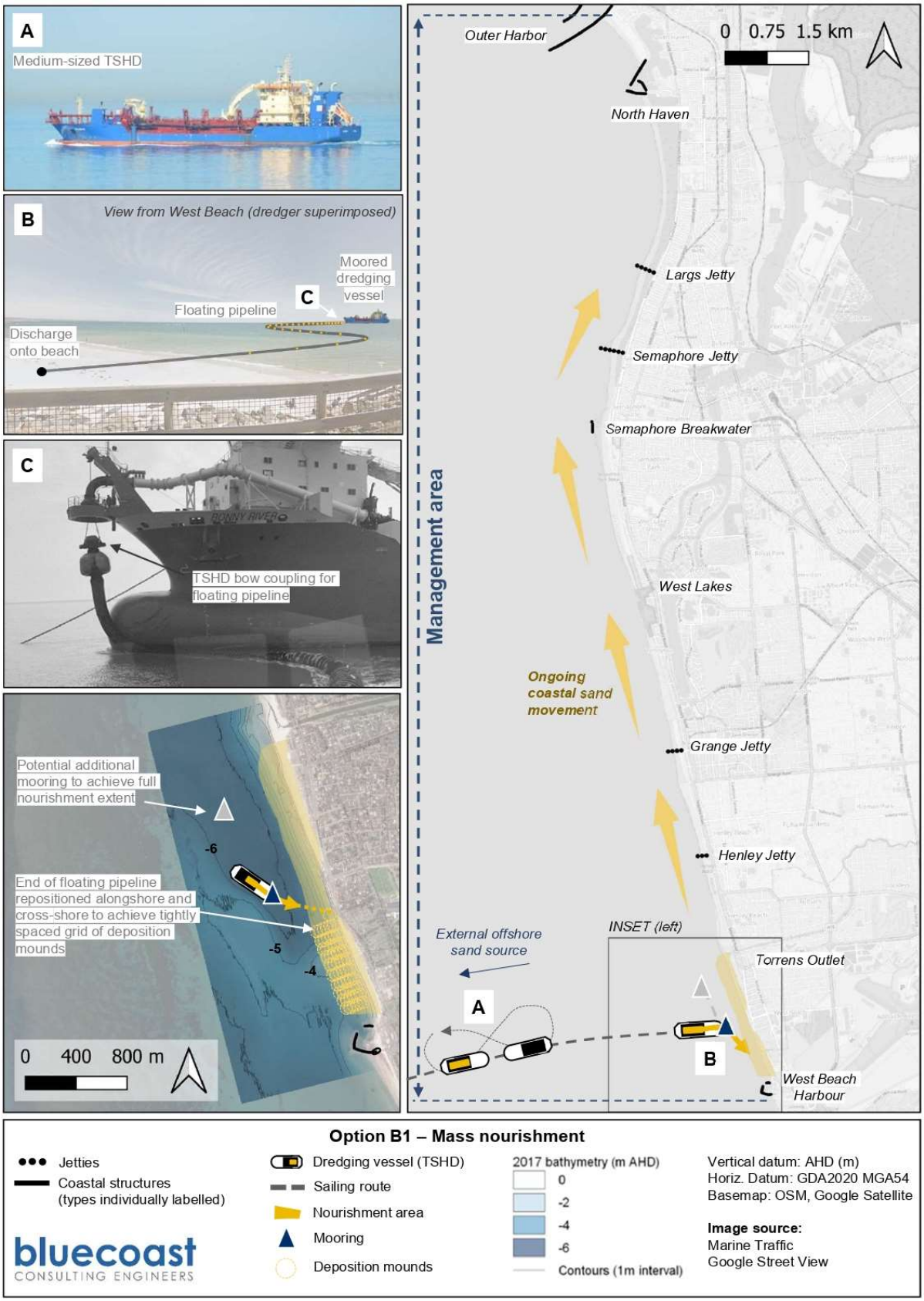


Figure 31: Conceptual design layout of the mass nourishment option (Option B1).

PRELIMINARY DRAFT - FOR DISCUSSION PURPOSES ONLY

bluecoast
CONSULTING ENGINEERS

6.6 Option B2 Ongoing nourishment using external sources

Table 19 outlines key details and describes this on-going sand nourishment from external sources option (Option B2). Figure 32 presents the conceptual design layout of the option.

Table 19: Description of the on-going sand nourishment from external sources option (Option B2).

Design parameter	Description
Concept and rationale	This option involves on-going sand nourishment at West Beach using sand from a range of sources (marine and quarries) which would be delivered via a series of nourishment exercises over a 20-year period. Under the 'keep sand moving' approach (see Section 5.3), it seeks to restore and maintain the supply of sand to the northern management area. The review assumes all sand would be placed at West Beach, the most updrift (southerly) beach in the management area. The rationale behind this option is that potential local sand sources prove to be limited and/or can't be accesses because of environmental, social or approval constraints. A range of scenarios, as outlined below, are considered as to how the required sand nourishment at West Beach may be achieved. Internal sand sources, such as collecting sand from the beach berm (i.e., subaerial beach) around Semaphore and Largs Bay have been assumed not to be available due to a lack of social licence to operate into the future. This review presents options that are early in the design development stage. There are other construction methodologies and/or sand sources that may be the focus after further investigations and design development. As with any beach nourishment project the final methodology would be delivered by the construction contractor.
Nourishment strategy	Nourishment frequency, quantities and durations Based on the sand budget outcomes (see Section 4.5) with consideration of sand sources (both currently and potentially available in the future), this review, assumes two scenarios for assessment: **Scenario A**: marine sand source(s) in the Gulf (within 20km of West Beach) becomes available after 5-years in 2029. In the interim, this involves the use of the most cost effective available external sand resources as: • Initial nourishment from Port Stanvac of 300,000m^3 using a small TSHD dredging (i.e., like Option A3) to partially restore the sandy buffer at West Beach in 2025. • Annual nourishments of 90,000m^3 via sand carting from quarries delivered to West Beach for the first five years (commencing 2024). • Secondary restorative nourishment for the remaining 250,000m^3 as well as four years' worth of the annual sand top-up quantity (i.e., 360,000m^3). That is a total of 610,000m^3 to be delivered to West Beach as soon as the marine sand source is approved and dredging contracted (assumed to occur in 2029). This would be completed with a small TSHD taking just under 12-weeks (estimated works duration). • On-going sand top-ups of 360,000m^3 every 4-years thereafter delivered to West Beach using a small TSHD over a 7-week works period. **Scenario B:** no additional (offshore) sand sources become available with all sand to be delivered from already approved sources. This has then been assumed to involve: • Initial nourishment from Port Stanvac of 300,000m^3 using a small TSHD dredging (i.e., like Option A3) to partially restore the sandy buffer at West Beach in 2025.

PRELIMINARY DRAFT - FOR DISCUSSION PURPOSES ONLY

bluecoast
CONSULTING ENGINEERS

Design parameter	Description
	• Initial nourishment volume of 250,000m^3 via sand carting from quarries delivered to West Beach in 2024 and 2025. • Annual and on-going sand top-ups of 90,000m^3/year over a single campaign delivered to West Beach over 3-month period in winter each year. Sand sources Sand for on-going nourishment under this option has been assumed to come from the most convenient sources, such that effort expended on investigations and approvals for additional borrow areas is reduced to a minimum. This includes sourcing the sand entirely from external sand sources, including: • Land based quarries, detailed of which are discussed in Table 24 • Offshore sand deposits in the wider region, specifically: ○ Port Stanvac, detailed of which are discussed in Table 27, and ○ The next available approved sand source, which for this review, has been assumed to be the 'Section Banks and surrounds' source. Details of which are provided in Table 26. Placement method and areas This option combines dredging and sand carting methods, which have been previously described with detail not repeated here. For dredging the placement method set out for Option A3 (see and Section 6.4) have been assumed to apply. For sand carting from quarry sources, the methods set out in the basecase, see Section 6.2, have been assumed to apply.
Implementation	Site investigations, project planning and environmental assessments Like Option A3 and Option B1, investigations of the borrow area(s) would be required to assess the resource and its suitability for beach nourishment. This would involve bathymetric and geophysical surveys, shallow (vibro-coring), possibly deeper geotechnical boreholes and sediment sampling and analysis. It is noted that these investigations have been recently completed at Port Stanvac with a 300,000 to 400,000m^3 sand resource confirmed. Should suitability be confirmed concept dredge and placement designs as well as environmental approvals, licences could be progressed. Environmental aspects at the relevant borrow sites are discussed in **Appendix A**. Environmental impacts would require assessment and likely to require dredge plume modelling, ecological (seagrass) surveys and baseline monitoring (water quality and possibly noise). For both scenarios, 300,000m^3 of sand from Port Stanvac is assumed to be available for use in 2025. For scenario A, these investigations and approvals processes are assumed to result in at least one additional marine sand source being realised and being available for use as a borrow area within 5-years (i.e., by 2029). During the planning period on-going sand carting from quarries has been assumed to continue. The sand carting elements and associated disruption to beach access and local roads for this activity are described in the basecase (see Section 6.2). For scenario B, no additional marine sand sources are assumed to be realised, with all subsequent sand assumed to be delivered via sand carting from quarries as is currently being undertaken.

PRELIMINARY DRAFT - FOR DISCUSSION PURPOSES ONLY

bluecoast
CONSULTING ENGINEERS

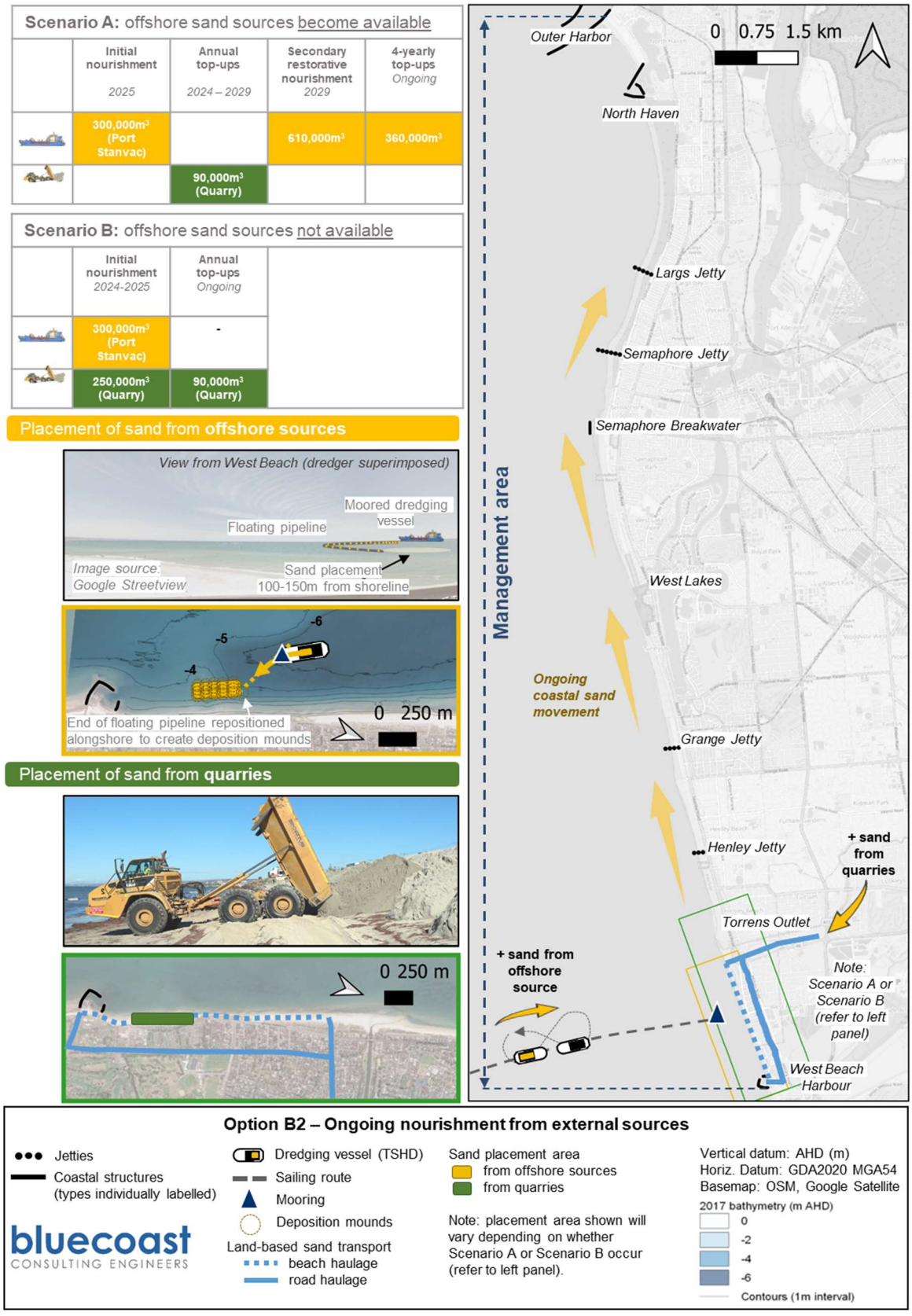


Figure 32: Conceptual design layout of the on-going sand nourishment from external sources (Option B2).

PRELIMINARY DRAFT - FOR DISCUSSION PURPOSES ONLY

Appendix B - Survey questions

Your Details

1. Name
2. Organisation:
3. Residential or business suburb:
4. Email address:
5. Which beach do you visit most often? (choose one only)

- ☐ Kingston Park and/or Seacliff
- ☐ South Brighton and/or Brighton
- ☐ Hove and/or North Brighton
- ☐ Somerton Park
- ☐ Glenelg South and/or Glenelg
- ☐ Glenelg North
- ☐ West Beach
- ☐ Henley Beach South and/or Henley Beach
- ☐ Grange
- ☐ Tennyson
- ☐ West Lakes Shore and/or Semaphore Park
- ☐ Semaphore South and/or Semaphore
- ☐ Largs Bay and/or Largs North

- [ ] Taperoo and/or Osborne
- [ ] North Haven
- [ ] Other (free text)
- [ ] Prefer not to say

6. What is your relationship to this section of coast? (tick all that apply)

- [ ] Nearby resident
- [ ] Nearby business
- [ ] Community or group, association or club
- [ ] Beach visitor
- [ ] Council, government agency or peak body
- [ ] Other (free text)
- [ ] Prefer not to say

7. What is your age range? [optional. choose one]

- [ ] Less than 18 years
- [ ] 18-24 years
- [ ] 25-35 years
- [ ] 36-45 years
- [ ] 46-55 years
- [ ] 56-65 years
- [ ] 66-75 years
- [ ] 76-85 years
- [ ] 85 years plus
- [ ] Prefer not to say

Your feedback

You can provide feedback on as many or as few of the 7 options as you like.

Full details of each option is available in the Discussion Paper.

Option 1.1 – Dredge existing sand near the shore

Sand would be collected from the seabed using a small dredge, which would sail south and pump the sand into West Beach using a floating pipeline that runs from the vessel to the shore, to deposit sand near the shoreline. Sand could also be delivered to other beaches as required.



8. What is your level of support for 'Option 1.1 - Dredge existing sand near the shore'?

    - Strong support
    - Support
    - Neutral / don't know
    - Do not support
    - Strongly do not support

9. Please tell us why you answered this way (optional)

Option 1.2 – Dredge using large offshore sand deposits

External sand could be sourced from the seabed at larger offshore deposits, including Largs Bay, Outer Harbor and/or Port Stanvac (subject to further investigations and approvals).



10. What is your level of support for 'Option 1.2 – Dredge using large offshore sand deposits'?

    - Strong support
    - Support
    - Neutral / don't know
    - Do not support
    - Strongly do not support

11. Please tell us why you answered this way (optional)

Option 1.3 – Combination of dredging offshore deposits and trucking quarry sand

External sand could be sourced from the seabed at offshore deposits, including Largs Bay, Outer Harbor and/or Port Stanvac (subject to further investigations and approvals). In addition, dredged sand would be complemented by sand sourced from land-based quarries.





12. What is your level of support for 'Option 1.3 – Combination of dredging offshore deposits and trucking quarry sand'?

    - Strong support
    - Support
    - Neutral / don't know
    - Do not support
    - Strongly do not support

13. Please tell us why you answered this way (optional)

Option 2.1 – Pipeline using tractors/trucks on beaches and trucking quarry sand

Sand would be collected onshore using machinery (trucks and scrapers) and fed into the pipeline through sand collection units. The sand would be pumped south through an underground pipeline and released at West Beach or other locations as required. Permanent booster pump stations would be located along the pipeline route. This would be complemented by delivery of sand trucked from land-based quarries or dredged from offshore.





14. What is your level of support for 'Option 2.1 – Pipeline using tractors/trucks on beaches and trucking quarry sand'?

    - Strong support
    - Support
    - Neutral / don't know
    - Do not support
    - Strongly do not support

15. Please tell us why you answered this way (optional)

Option 2.2 – Pipeline using dredge pump systems on jetties and trucking quarry sand

This option involves a pump operating from a crane on the Semaphore or Largs jetties and submerged under the water. The dredge pump would mobilise surrounding seabed sand, which is then pumped into the pipeline system through a pipe under the beach. This would be complemented by delivery of sand trucked from land-based quarries or dredged from offshore.



16. What is your level of support for 'Option 2.2 – Pipeline using dredge pump systems on jetties'?

    - Strong support
    - Support
    - Neutral / don't know
    - Do not support
    - Strongly do not support

17. Please tell us why you answered this way (optional)

Option 2.3 – Pipeline using a temporary dredge and trucking quarry sand

A small sized dredge would collect sand from the near shore seabed and pumped directly into the pipeline through the nearest collection station. A mobile collection method using a dredge provides flexibility on where sand can be sourced. This would be complemented by delivery of sand trucked from land-based quarries or dredged from offshore.



18. What is your level of support for 'Option 2.3 – Pipeline using a temporary dredge '?

    - Strong support
    - Support
    - Neutral / don't know
    - Do not support
    - Strongly do not support

19. Please tell us why you answered this way (optional)

Option 3 – Moving sand using trucks and machinery and external quarry sand

Sand would be collected from the beach using an excavator and front-end loader and trucked to areas where sand is required. External quarry sand would be delivered using trucks on public roads. Excavators would be used to move the deposited sand to achieve the desired beach profile. e.



20. What is your level of support for 'Option 3 – Trucking sand from beaches and quarries'?

    - Strong support
    - Support
    - Neutral / don't know
    - Do not support
    - Strongly do not support

21. Please tell us why you answered this way (optional)

22. Do you have any other feedback (optional)?

Thank you for providing your feedback.

A report on the engagement outcomes will be prepared by URPS and provided to the Independent Advisory Panel overseeing the review.

If you would like to speak to the Panel in support of your survey response or written submission, please complete the form available at yoursay.sa.gov.au/abmr-shortlist

Appendix C – Verbatim comments from survey

Please explain your level of support for Option 1.1 - Dredge existing sand near the shore

damage to seabed
Would prefer a permanent whole coast pipeline, this is robbing Peter to pay paul.
The damage to the underlying seabed concerns me
Destruction of sea life habitat and visual impact. In addition, this option has on-going emissions production from a boat powered by fossil fuel.
sounds good however i dont know if it does any damage to the beach
This seems like an option that has the lowest cost and smallest level of inconvenience. The environmental impacts are not stated so my support is on the basis that seabed issues have been properly investigated
Seems likely to operate on a weather dependent basis, was this modelled in?
Let Nature do its job.
on data presented :
Lowest cost (Estimates are selection phase so little engineering completed to get to better than +/- 50%
seemingly least environmental impact (questionable)
Support what ever is required to maintain a usable beach.
Loss of sea grasses. Loss of various living forms eg crabs What time of year will it occur. Winter can be very rough on water.
Your cost estimate for dredging does not reflect reality and the real cost of this would be multiples of what is stated.
Any dredging operation would be the most damaging to the environment and will do nothing to remediate the massive sand deposits that have built up since sand management stopped at Semaphore
Minimal impact to the beach and to beach users. Reasonably quick to transport the sand.
Dredging is harmful to the ocean environment
The heading says "near the shore". The notes say 2 km offshore. If it is really 2 km offshore, then I would be more supportive.
Faster. Easier to start soon.
Disrupts sea life, required diesel machinery
Sand deposits close to shore will be naturally moved onto the shore by ocean currents
Concern that taking sand close to shore could create problem for nearby beach

Insufficient reliable sand sources
Cheaper option
It seems to be less destructive to Semaphore and Largs beaches as it will source sand from offshore
The natural sand drift requires management and a range of solutions may be required.
Small effect on foreshore. Cost compares well.
Irresponsible, carbon intensive , ineffective
Disturbance of sea grass
Better than using current method at Glenelg. Unable to walk on beach whilst trucks are diving up and down beach . Also they take so much sand from Glenelg we are left with a lot of rocks through out the year .
Short term, non sustainable solution only, highly disturbing and will involve discharge of highly turbid water from the supernatant from the onshore pumping. This will undoubtedly impact the existing seagrass beds
The sea grass needs to be protected
Negative impact on seabed and reed beds. Very localised and does not address overall problem of sand migration.
Least cost and low impact on traffic.
Significant disturbance to ocean bed and all the plants and animals that live there.
Keeps the problem and solution localised
Cheapest
Doesn't eliminate trucks and is an eyesore.
Where will this sand be dredged from?
Will this complement the natural order or create a new problem.
Cost effective solution that avoids the incredible disturbance and noise of beach excavation.
I watched the previous dredging exercise off Brighton years ago and it temporarily repaired the dune buffer between the Esplanade and high tide mark
Not a long term fix
Sea grass disturbance
Minimal impact on the beach and dune system
Unclear on effects of dredging on sea grasses and fish. Seems likely to prevent near shore regrowth of seagrasses
Least invasive option.
Beach goer friendly as no trucks
Most economical option

Worried this would effect the offshore and nearshore marine ecosystems
Environmental damage
I think it would provide sand with the least disruption to the beach goers, strong concerns about the damage it will cause to the sea bed and the surrounding marine life
Will disrupt the marine environment and beach enjoyment
Damage to the weed and rock beds on the ocean floor
Only support provided there are sufficient volumes in the near shore area designated for removal, and that removal does not accelerate the long shore drift.
Also recommend consideration be given to further use where deemed appropriate of the low profile groins formed by geotextile fibre sand filled containers as trialled on Seacliff and Brighton beaches to slow the northerly sand dift and retain more sand on the adjacent beach. I understand they have bern somewhat successful.
Need further information and see study done on impact of sand whiting and blue swimmers.
As an interim measure, it is incredibly cheap and easy to implement. In at least one case you wouldn't even need a hopper dredge to get sand from the nearshore back on to the beach. Sand particle size and connection with the beach system, as well as the impact of structures, are key considerations. if you let sand from Glenelg beach infill Holdfast Quays channel, the dredge that is permanently situated there could be pumping sand and seagrass on to Glenelg North beach and that sand would, if it were not back-passed to Glenelg, eventually round the West Beach boat harbour breakwater, where it could be dredged back up on to the nearshore bar West Beach. Trickle feeding sand into the nearshore bar with smaller accumulations of sand that are situated close to shore is a good interim measure but not very sustainable in the long term when you have to start searching out smaller and smaller deposits, spread over a larger and larger area.
I feel both dredging option will deliver large amounts of sand which is what we need.
No evidence of sustainability / concern of available resources over decades to maintain this work
Using Quarry sand is not an infinite resource.
Removal of Beach sand from one location to another isn't that great for public use.
Slow, expensive and weather dependent.
There was not sufficient information in the discussion paper to make informed input. There was no assessment of environmental impact of options or carbon emissions impact. There was no long term system change options presented. There was no explaination of why other options were not assessed. The options represent status quo and are not suitable options.
It's better than mining the dunes and having large trucks on the beach carting sand. I am concerned about the impact on seagrass beds though.
No truck/tractor on the beach. can deliver to other beaches.
I think dedging of any kind is going to destroy the ocean. But the fist 3 options seem like the beat options in terms of disruption to the ocean and the environment

The seabed is also at risk and should not be destroyed.
Sea grass is critical habitat for sand forming organisms
Disruptive
Least disruption to beach use and intertidal zone
Still needs environment impact study
Only support at 2kms offshore, environmental impact statement required.
Require an environmental impact statement
3km off shore apparently will work and not be too disruptive An environment impact report will be needed to see what the impacts will be (sea grass etc)
If it needs to happen to maintain coastline then fine, however needs to avoid significant fish grounds that you may not be aware of.
What harm would be done to the places where the sand was dredged from...?
Might have less impact on our shores
This process is weather dependent and expensive to maintain
It would be helpful to know how much damage each option would do to the sea floor/enviornment. But I suspect its dedgraded already.
My reasons to prefer this option:
1) Lowest cost,
2) appears to be most sustainable because it relocates the sand that has moved north back south where it oroded from,
3) appears to be least disruptive (to land dwellers) because it doesnt involve trucks, only needs an initial setup of 4 months, and each 4 yearly top up completes in 2 months.
Im yet to be presented with the effects of dredging on the beaches
Disturbing the sea bed . Destroying sea grass beds , killing crabs and fish .
Local resource
This seems a good idea but what is the environmental effect on the sea bed?
I feel the need to rebuild the full beach profile of the unhealthy beaches. A nearshore dredge would be mining close to the beach which could cause further problems and would also be an eyesore...this question doesn't define which near shore beaches it will be dredging from.
This will have heavy destructive impacts to the sea bed and water clarity, destroying marine life and habitat.
Significant environmental concerns
Environmental concern for local beaches

Research and use of this system from other countries shows that this method is effective and it will also cause less harm and disturbances to the beach and close by residents.
Prob one of the most economical ways, as long as it does not destroy amenity of those beaches
eyesore
No trucks on beaches. Sand not taken off beach. Dredging would need environment impact assessed to ensure the nearby beaches were not effected.
Depends on definition of near shore. 2 km is suggested - I would support this off North Haven but not closer to shore.
Concern that dredging close to shore may adversely affect beaches and water quality where sand is being sourced.
Disruption to sea life
I would prefer that the environmental experts are consulted. The ecosystems associated with the ocean should not be disturbed because development has taken place that has destroyed natural vegetation. Curb high density development which comes with increasing storm water run off that is ruining beaches, sea life and water quality.
Too disruptive to the environment - no risks of this provided.
Slow, cumbersome and costly. Too much disturbance to coastal marine environmnet
It's better than onshore disturbance
The other options are disastrous. We need the independently review the impact of this option once it has been rolled out
The areas targeted for dredging haven't recovered from the last sand-mining. You clearly don't visit Semaphore South => Largs beach or you'd know this.
The sand will be taken 2 kms from the shore
Sand will then be placed off shore at West Beach to be washed in rather than placed on the beach to be washed away at the first high tide which has been unsuccessful for the last 20 years
No trucks on any beaches
Also am pleased to read turbidity monitoring and sea grass surveys are spoken about
This has less impact on the beaches, dunes and safer for all beach goers. The sand can be delivered to other beaches if needed and the costing is good.
there are better, successful erosion mitigation strategies on sandy beaches, as is clear from other countries management e.g. Wales, Netherlands etc e.g. artificial reefs, groynes etc. https://oceangeosynthetics.com/ways-to-prevent-beach-erosion/
As long as ecological measures are used to prevent unnecessary damage to fauna
Provides flexibility for solving the sand problem, and also provides a visible educational opportunity for local schools and residents who may be interested in learning about environmental impacts and safeguards

Too close to shore and floating pipeline is an eyesore
Remove Adelaide shores groin
It is the cheapest option and involves the least disturbance to bach users (no trucks or pipelines along beaches)
Short term solution only with disruption to beach users.
This is the best option that keeps machinery off the beach.
Seems cost effective but will degrade one beach to help another
impact of environment and amenity use of the northern beaches and jetties
I don't know the environmental impact. Wouldn't this be detrimental to sea life on the sea floor?
What it might do to the local marine ecosystem and beach safety
Close to shore will not impact wildlife as much
I believe dredging will disturb the ecosystem and this has not been addressed through the planning documents or FAQs.
The creation of a previously DHI recommended style of "sand motor" solution is most flexible and likely to be a successful solution given the Dutch experience at the Hague.This is still an ongoing experiment but the results are improved amenity recreationally and fauna and flora restoration,dune and beach maintenance and a lagoon for water at 10 plus years
The flexibility to attend to additional hotspots in addition to west beach without is a plus .
The main issue to be resolved is a viable sand source which applies to all of # 1 options 1.1,1.2 1.3
Something has to change
Harm to beach.
Damage to fragile seabed. Disturbed surrounding water.
This seems to be the most sustainable and cost effective process and causes minimum impact to beach users and residents.
disruption to the serenity of the beach and damage to the ecosystem (I am a PhD level Marine Biologist)
Less disruption to beach from machines and taking sand off the beach
Less obtrusive than trucks on the beach and more cost effective.
The volume of sand sourced off shore Largs Bay, location of sand, quality of sand untested. EPA approval unlikely, untested. EIS unlikely, untested. Total 'nonsense' as a genuine option. 820,000m3 therefore greatly improbable.
Placing deposited sand, west of surf break, unlikely to benefit West Beach and rebuild beach and dunes. No guarantee or trust that successive govts will follow on and undertake every 4th year top up of 360,000m3.
360,000m3 again questionable as with the remarks of the 800,000m3.

To close to shore and will add to dune erosion and sea level rise from climate change.
Visual amenity and high ongoing costs
Least expensive and minimal impact to beach use.
Best value, minimal disruption
This has been floated for years and seems to have reasonable support. Obviously concerns about seabed vegetation at the dredging site, however surely this can be mitigated.
It's not a long term solution.
Damage to seabed, flow on effects once sand removed
You'd see the dredge from the shore and would still involve an initial large quantity of sand being taken from North Haven, meaning more sand carting. Seems a short-term solution.
Minimal impact on beach environment and allows unrestricted pedestrian access. The sand carting over the last few years is very disruptive and destroys the beach scape.
I have witnessed and been effected by sand collected from our Largs and Semaphore beaches: beaches scraped bare to ugly puddles of salty water, trucks driving at dangerously high speeds and, in general our beach areas - commonly visited by many from the Adelaide northern suburbs, and as far north as Elizabeth etc - made to appear industrial and extremely unappealing; a great advertisement for those wishing to enjoy our Adelaide beaches - summer or winter, there latter of which we enjoy most!
Anything but beaches scraped bare - including for the useless, bandaid proposal of a pipeline!
Cheaper. Less impact. Less visible.
Does not appear to be a long term dolution
Very limited information has been provided in your consultation paper, but dredging has been used extensively elsewhere e.g Dubai to create the Palm etc. to god effect. It appears to be the most cost effective and least disruptive option, and I suspect it may be the most environmentally friendly option overall, subject to more detailed impact assessment. If the sand it taken from non-sensitive areas e.g. not affecting seagrass and other important sensitive marine environments, this appears to be the best option from the those listed.
Seems the best solution - use sand that is already in the sea and use a dredge/floating pump so there is no need for trucks, permanent pieplines etc. It seems the least disruptive and most ecologically pleasing option.
Negative impact on the ecosystems and sea life
Less destruction of the beach. Less noise and CO2 emissions from the diesel motor
stupid, construction out rules profit, look into using regenerated sand from recycling or ban stealing shells and encourage sea life that bring shells and life. ALSO, stealing sand only fixes a problem with another problem and so not a long term plan. just dumb

You don't provide enough information. Would the dredging affect ecosystems in the nearshore? Dredging causes a lot of turbidity. Why would you dump the sand at west beach and not further south?
Cost effective sensible flexible environmentally sound solution that has been proven to work.
Not a deliverable outcome
I feel very strongly that the decision on how to treat our beaches must NOT be in the hands of just anyone. These decisions must be made by people with marine and environmental science expertise. We need to use the best system according to what the science says to help fix and protect our beaches.
The near shore sand bars help reduce the storm wave impact on the beach.
Least interference to beach goers and bnearby residents
Technically good idea but unlikely due to siltation.
It would be too disruptive to the coastline and costly.
Least amount of interference with beach activities, and the cheapest
Too much sand build up at Largs North
Want to leave the sea as natural as possible, only revert to this if absolutely necessary.
Over the last 40 years the taperoo Beach has extended from the start of the north haven southern revetment wall to half way to the end. This sand flows into the marina area causing the government to dredge the channel every 2 yrs.. Sand should also be sourced from the silt grounds between outer Harbour as this sand was from the dredging of the port river and is of a lager particle size whis will move a a slower rate from west beach
I support this option as long as it's at least 2kms offshore. It is the least disruptive to beach goers and the beach and dunes environment (ecosystems). But I am concerned that an environmental impact study needs to be done prior to implementation.
This solution meets all three requirements of minimal disruption for all communities, avoids environmental harm (with an EIS) and maximises sand staying on beaches because it would be coarser grain sand. It's clearly much cheaper than the sand pipeline destructive white elephant. So it's a no brainer that this and option 1.2 are the preferred options. Dredging and depositing sand on the near shore is happening around the world with much success including in Australia. It is flexible and would be responsive to hot spots of erosion along the whole coast not just West Beach
Possibly at 2km offshore. Environmental impact statement required
I do not believe this will be acceptable to locals. The jetty would be closed for long periods. It would be visually unacceptable. Given the amount of sand under the jetty, this feels like an unrealistic option. Not sure of the impact of dredging close to shore, impact on seawater, marine life.
Environmentally friendly and sensible.
This is a preferred option and I would strongly support this, only write "support" because lack of information about the definition of "near shore" and need for clarification about the environmental

and social impacts. I am concerned about the quality and supervision of the works to ensure correct large grain sand is collected and negative impact on sea grass beds and associated marine environments are minimised
This sounds like a better option than the destruction that would result from building a pipeline, but it requires an Environment Impact Statement to make sure it is better on the environment.
I have lived interstate and sort of worked well but you must make sure its ok for the environment
Possible at 2 km offshore. Environmental Impact Statement required.
Just not sure about this one
Damage to existing seabed
This activity will impact negatively on the West Beach coastal environment and the ability for our club to conduct its core business of sailing off of West Beach boat harbour when the dredge ship delivers its sand cargo.
This option will also have a negative environmental impact of the near shore sea floor - sea grass etc.
Why harvest sand from out to sea when the sand that's missing from West Beach and other areas is now sitting on Largs Bay and Semaphore beaches?
Possible at 2 km offshore. Environmental Impact Statement required.
Short term solution only
Environmentally damaging
Sand off Largs Bay is likely to be approved by EPA with no testing of sand as I know of. Placing sand West of the West Beach surf break means no sand for the beaches and dunes for West Beach, South Henley or Henley Beach. The sand that is on the beach moves North when it is in the water, if this step is missed of placing sand on the beach you are just speeding up the sands northern movement and therefore achieving nothing for West Beach or Henley. With no mass fill onto the beach I can't see how we can get back to a 1970 beach standard which is the benchmark set by all governments.
Environmental and Visual impact of dredging close to shore.
Less impact to the beach and users
if possible at 2 km offshore. environmental impact statement required.
Environmental concerns
approved by EPA with no testing of sand as I know of. Placing sand West of the West Beach surf break means no sand for the beaches and dunes for West Beach, South Henley or Henley Beach. The sand that is on the beach moves North when it is in the water, if this step is missed of placing sand on the beach you are just speeding up the sands northern movement and therefore achieving nothing for West Beach or Henley. With no mass fill onto the beach I can't see how we can get back to a 1970 beach standard which is the benchmark set by all governments.
Clean sand only

It will destroy Seagrass beds and ocean floor sea life
Has no impact for visitors to beach or areas the grass areas behind the beach. No eye sore infrastructure or land noise to spoil the beautiful environment
Dredging near the shore is ineffective as the beach sand will wash into the dredged area.
The disruption to sea grass beds will be exacerbated.
No confirmation of how much sand will be able to be dredged ….
Other environmental impacts to seagrass & sealife.
I'm unsure how it works
If environmental impact carried out and well offshore
It will disturb the natural flow of water
Cost effective. Doesn't seem as intrusive with machinery on the beach
disturbs and disrupts the underwater ecology. danger to sea grass. makes the water murky and un swimable.
Least cost and impact on the beach but am concerned about environmental impact on seabed
The dredge blocks the beach--the sand will wash back at next high tide
Least disturbance to beach, dunes, beachgoers, sand, ecosystem. What disturbance there is is limited to a smaller section of the ocean and targets the most needy beaches eg West Beach without destroying other Adelaide beaches. This option is also flexible in terms of dredging/pumping location and can be used to supplement any eroding beaches sand, or reduce sand where there is too much. It is also the cheapest option
I oppose sand carting and a pipeline, so taking machinery offshore away from community is the most favourable option - however - what is the environmental impact of this? How will it effect marine life? How will it effect the shoreline? I can't see any information about this in the options you have provided info about. This isn't acceptable as how can community really provide their say when all the information is not being provided?
DEW has told us for the last twenty years that the quantities of sand needed do not exist in St Vincent's Gulf. They are the government agency who have continued to research this fact. We need action now.
Dredging has less impact on Beach users, and is the most economical.
The impact of trucks on the beach means that i cant walk on the beach because the sand becomes too soft, as well as the social impact of noise and large moving vehicles.
To keep the Trucks off the beach
There is no sand available at west beach
As long as it is at least 2km off shore and an environmental impact statement is done.
There is not enough information on this option. How far close is 'near the shore'?

Questionable viability
Not expensive and efficient using built up sand from longshore drift deposits.
Not viable
Not good environmental practice to disrupt the sea bed, will destroy sea grasses. Also requires approval, so this is not a given resolution
So long as an environmental impact statement is done and adhered to.
I dont support solutions that may further degrade our sea grass beds. Also dont believe we have sufficient volume of offshore sound for this to be a feasible solution. Do not wish to see a dredge frequently offshore.
There isn't sufficient sand for this option.
This would effect the flora and forna on the ocean floor and harm wild life
Dredging seems to be the least invasive but not much info on environment on info sheets
Dredging seems to have minimal environmental disruption according to the discussion paper as evidenced by previous Port River excavations and impact on sea grasses. There would be no impact of heavy equipment on my local beach, there would be no impact in recreational fishing from the jetty from option 2.2. This appears to be a cost effective solution, it is environmentally and socially acceptable as our beach amenity is not impacted and the foredunes are not mined every year causing further coastal erosion. West beach is provided with its sand buffer without resorting to further harm and damage to the northern beaches. Also if Henley and Grange beaches require buffering this could also be accommodated.
A seaborne solution to beach sand renourishment is the optimal methodology (by far) from a holistic environmental protection stand point, cost effectiveness and social utility (human impact).
There are, however, better technical solutions than suction dredging. (I am aware of a commercial Briefing Paper that was submitted to DEW in August 2021 that canvassed the issues surrounding beach sand loss and replenishment and offered a local solution: 'Seaborne Sand Replenishment System')
Beach is kept clear for users, no heavy machinery, low impact on environment, not restricted to one beach but can be utilised more widely as required
There will be less impact on my local beach. I support provided there is an environmental impact study done to ensure it will not be detrimental to the environment.
This technique requires no heavy machinery on beaches preserving beach amenity, provides total flexibility to where sand can be delivered, places the sand in the nearshore where it can be most effective in restoring beach profile equilibrium using natural forces and is sustainable with increasing sea level rise. It is also one of the most economic solutions.
Prefer dredging offshore to this. Oppose the pipeline and trucks on beaches

This option ticks many boxes. It gets the trucks off Semaphore beach, restoring amenity and easing environmental degradation while also being the most cost-effective solution. Of course, environmental impact assessments would need to be carried out.
Too close to shore & have an environmental & aesthetic impact on beach goers (along Semaphore sth through to semaphore & beyond through to Largs nth) many of whom (are from lower SES status & or newly arrived migrant / refugee communities) travel from inner / outer northern suburbs.
Its not sustainable
Least invasive to beach. Uses local.sand rather than bringing in from quarries
An efficient effective way to move large quantities of sqnd. Low impact on the beach, Cost efficient. Low impact on beach users
Scientifically proven and cost effective.
Is not environmentally sound
Don't know enough about it. From what I have read.
Concern with the impact of dredging on the sea bed and on the coastal system generally
Dredging sand is NOT an option due to destroying (smothering and choking) reef and seagrass habitat. Dirty water blocks sunlight and so kills seagrass. Thick silt cover kills healthy reef habitat.
We have already lost 80% of seagrass along metro Adelaide. Dredging would reverse the increase in reef and seagrass health
Seed for Snapper project - fishers
Waste water - Bolivar
Greenfeilds wetlands /recycles water
Shell reefs
I am strongly opposed to the sandcarting and pipeline projects, and this looks like the most flexible and acceptable to the Semaphore and Largs Bay communities. My response is dependent on an Environmental Impact Statement/Assessment of impact on the seagrasses and the suitability of sand sources marked for usage etc. I marked strongly on the assumption that the deposits are more than 2 km distant from shore.
Keeps trucks off beaches and no harmful pipeline
This seems like the option that is the least disruptive and cost effective.
All options do not give sufficient attention to the environmental and micro-organism/micro-crustacean impacts of moving sand or adding quarry sand - i.e. actual and potential environmental impacts.
Minimal intervention in terms of timeframe.
No information on the environmental impacts or considerations were included in the discussion paper.

Possible damage to sea life/environment. Why not take sand from where is building up north of Largs jetty? Sand dunes are growing wider.
Cost effective over time. Avoids having large machinery operating on suburban beaches which presents risks to beach visitors.
Poor for the environment
I do not support close shore dredging creating a drop off break
Need an environmental impact statement however
No Sand taken from existing beaches
The marine life of the Adelaide cost should be protected and I believe this dredging would adversely impact the marine environment
What are the environmental impacts?
Possible at 2km offshore . Environmental impact statement required.
Following surveillance and photography over the past 3 years it is clearly evident that excavating and carting sand from the beach is having a deleterious effect on the coastline and the environment. Since May 2020 when my photographic study began the original dunes have been eroded and stabilising vegetation washed away. The compaction caused by the machinery used in the mining operation further adds to the speed and volume of wave action impacting the dunal degradation. There is no evidence that there has been any replenishment of the removed sand since May 2020. I am happy to provide photos as evidence if requested.
It is the least intrusive and disruptive for those of us onshore. It is also less expensive than other options
Not enough education provided re pros and cons
Too little is known about the environmental impact with a close to shore operation
The review does not consider the effect of dredging on the offshore environment
Less likely to cause disruptions to regular beach goers.
Sand collected should be fresh, not have established habitats
This option looks to utilise sand near to a major depletion area and we have see historically the impacts of localised sand relocation and how it changes the dynamics and gravely impacts the surrounding area
Least impact on our beaches
There is alot of sand out past the boat harbour that could be pumped in
There isn't a dredge capable of doing this available to support this option
Least disruption and destruction of Semaphore beach and surrounding beaches less expensive
just use exiting infrastructure as basis for transporting from the northern beaches.

Adding sand West of the West Beach surf break means no sand for the beaches and dunes for West Beach, South Henley or Henley Beach. Beach sand moves North when it is in the water, if no sand is replenished by placing sand on the beach, then the northern sand movement is just being accelerated with no benefit for West Beach or Henley.
Environmental issues with sea grass
A seaborne solution to beach sand renourishment is the optimal methodology (by far) from a holistic environmental protection stand point, cost effectiveness and social utility (human impact). There are, however, better technical solutions than suction dredging. (I am aware of a commercial Briefing Paper that was submitted to DEW in August 2021 that canvassed the issues surrounding beach sand loss and replenishment and offered a local solution: 'Seaborne Sand Replenishment System')
I think the sand needs to be delivered to the beach, not (just) off the beach.
this sounds like it would disturb and disrupt the environment of sea life out where the dredging occurs.
Near the shore is too close , potential disruption
1. Dredging is major issue for seagrasses either by generating plumes or direct impact. Other benthos would be impacted. I would be very surprised that any dredging operation within the Adelaide metropolitan area would pass an environment impact assessment or meet EPA requirements.
2. To my knowledge there is no suitable large size surface deposit at North Haven. Possibly there may be suitable sand beneath the surface layer but this has not been established. An attempt to get a jack up drilling rig to the site did not eventuate.
3. Generally the local offshore sand at North Haven is fine and calcareous and not economically suitable for replenishment purposes. It is classed as unstable using the James method when tested against the native Adelaide Beach composite sand therefore moves away from the replenishment site very quickly.
4. Dredging creates a depression and along the Adelaide coast these depressions fill with seagrass detritus, which become a nuisance environmentally and for dredging operations. Previous sand maintenance dredging undertaken north of North Haven experienced this issue.
Activity near shore will negatively impact beach use for a large number of the community. The mobile dredge and floating pipeline will have a negative impact on how the beaches can be used and will make beach use uncertain (dependant on location of dredging). This will impact a large number of communities across those beaches where sand replenishment is required.
The sand that moves to Largs/Semaphore needs to be returned to where it came from Westbeach and Henley, dredging from local beach will continue to reduce sand at Westbeach and increase sand at Semaphore
Because dredging will disrupt marine life, sea grass, food source for marine life.

Interfering with the environment will be a never ending waste of time, resources and money, which can be better directed by the Government into more productive areas such as Hospitals, Roads and Schools.
Damage that would be caused to the marine habitat.
No impact on the beach area
- No trucks on beaches
- Flexible and adaptable
- Barge can dredge sand from a number of appropriate sources and deliver to anywhere there is erosion along the metropolitan coastline
- Possible offshore sand sources need an Environmental Impact study on possible impact to sea grasses and marine and bird life
- Cost effective
- Cost less than Options 2 and 3
- No mining of beaches required
- Much less community disruption compared to pipeline and trucking
- Will build beaches rather than lower them
- No beach is degraded to advantage another
- No environmental harm to dunes compared to the pipeline
- Has been proven to work well in other places in maximising sand staying on beaches
- Less ongoing intervention and maintenance
Potential impact to dunes
To fix up the mistakes of the breakwater and keeping west beach surf club at same location
Not good environmentally
Dredging damages the fragile ecosystem of the sea floor just off of the coast and effects wave action which in turn cause further unknown consequences.
Primarily anything that negates sand carting
Not natural, disruptive to marine life, alters contour of sea bed and turbidity of water
This would keep trucks off our beach
I believe this option will impact further on the already scarce seagrasses and increase turbidity
This is a crazy idea as the seabed needs protection for the marine ecology and the idea of dredging in winter is impractical for both the dredging and application of sand which will wash away
Economical and doesn't impact beach or road use. Sand moved from beach to beach, less impact on marine life away from beach.

Dredging near the shore lowers the sea bed in that area, creating more harm to the beach - similar to when the beach was lowered at West Beach 7 years ago, creating massive dune erosion there.
Most flexible of 3 options put forward. Least disruptive to beach amenity and communities, most effective in keeping sand on beaches, Most cost effective.
Only if 2+ km from shore.
Least disruptive, long lasting, economical. Multi beach uses. Only with positive Environmental Impact Statement .
Minimal impact to beach users
Removes trucks from beaches, replenishes beaches with sand from environment, not quarried sand.
Environmental damage to seabed, seagrass, marine animals
- No trucks on beaches
- Flexible and adaptable
- Barge can dredge sand from a number of appropriate sources and deliver to anywhere there is erosion along the metropolitan coastline
- Cost effective; no need to buy sand from commercial quarry
- Cost less than Options 2 and 3
- No mining of beaches required
- Neglible community disruption compared to pipeline and trucking
- Will build beaches rather than lower them
- No beach is degraded to advantage another
- No environmental harm to dunes
- Has been proven to work well in other places in maximising sand staying on beaches
- It's quick. Less ongoing intervention and maintenance with top ups every 4 years
There needs to be a process involved to compact the sand once it arrives at West Beach. Otherwise, it will just be "swept" away continuously. This isn't a long term, ethical, sustainable solution
This option provides flexibility, gets trucks and equipment off beaches, is cost effective, can provide mass nourishment, doesn't involve costly fixed infrastructure, stays away from dunes and foredunes thus allowing them to recover from past sandmining and provide protected habitat for nesting shore birds, potentially will restore heavily scarped foredunes and loss of plants, minimises disruption to communities, is less environmentally damaging, reduces microplastic deposits compared to pipeline options and potentially increases the chance of sand remaining in areas that need nourishment. Proviso - independent environmental evaluation.
I don’t understand how this option will impact the environment, it is also unclear if the equipment can be sourced.
Machinery is off the beach

Minimal disruption
Will the sand be pumped on the beach?
Not feasible and a source of sand has not been identified
Seems like a less intrusive option
Better than carting by truck. Commitment to this option may accelerate technology in this area.
Environment protection
the dredging site can be flexible according to needs
less disruption, reasonable cost
No trucks. Not much interruption. Good value for money
This is a short term fixed, and requires a vessel in the area at all times
It would bring sand from the northern beaches back to the central beaches.
It apears to be the option that causes the least damage, re digging up along our coastline. It took years to get a walking path through tenyson so what will.people say about a pipe.
Secondly the equipment can be serviced and stored elsewhere when not in use.
Thirdly it may encourage better growing conditions for seaweed growth which i think is our best long term option.
Would erode the beaches here quicker
The environmental impact. To the seabed & the shoreline. There is no use taking sand at semaphore for west bay as semaphore is eroding too. This is a ridiculous short term plan & I see no back up evidence or environmental impact study to back this up?
The sand that has eroded from West Beach, Henley South and Henley Beach drifts to Semaphore and Largs Bay. It doesn't seem logic to dredge from the seabed and further impact the sea floor/ grasses etc, when there is a huge buildup of sand on the northern beaches, abovementioned.
This dredging will impact the West Beach coast environment when depositing the sand cargo.
EPA approval ??
Because it has the least disruption to other areas
Dredging sand near shore is not considered a viable option because dead drift seagrass is prevalent on the Adelaide coast, and once dredged smaller particles are produced to impair water quality in the discharge. This can only be avoided using a cleaning screen device on the dredge or at the discharge point and removal of detritus, requiring machinery on the beach. Dredging was originally considered as a sand collection method for the sand pipeline at Glenelg but was abandoned because of concerns to meet the water quality and odour standards of the EPA at the discharge locations, despite the provision of a ponding swale at Brighton.
Dredging creates depressions in the seabed which quickly fill with dead drift seagrass. In turn, when the area is redredged, entrainment is exacerbated, further impairing water quality. This is particularly an amenity problem inshore of the sandbars where most swimming occurs.

Protection of the dredge and discharge pipeline is difficult on the open coastline of Adelaide, as demonstrated at North Haven where a barge had to be sunk offshore to provide protection. At a Torrens Outlet trial, the pipeline was severely damaged during a one in a hundred year storm.
See Adelaide Coast Protection Strategy Review 1984 report p211 to 224.
The current dredging operations at Glenelg and West Beach harbours have the benefit of nearby protection for dredgers.
Although dredging seems a reasonable option, I do not know how this would affect sea creatures living in the area. Moving sand that distance only seems justified if there is a genuine build up of sand in that area, as opposed to dredging it rather closer to West Beach.
impact study required, possible 2km offshore
Not proven option. Too untested.
Environmenal concerns
Disruption and damage to sea grass and marine life.
Interference to sandbars and safety for swimming and beach goers. Environmental Statement required.
This would be devastating for costal dunes and local birdlife, and significantly impact local resident's enjoyment at the beaches you are dredging on!
This is possible at >2km offshore only - but an environmental impact statement is required
Disturbs seabed
Damage to sea bed and not enough sand to dredge.
This option possible 2km offshore. Environmental Impact Statement required.
Ruins marine life and makes the coast more vulnerable to storms
Given my experience of flying over the coast at slow speeds and at low levels,I dont believe there is sufficient sand reserves offshore to pump from
Possible at 2km offshore. Environmental impact statement required
Not sure if this would impact sea creatures living on the sea bed?
Damage the sea bed
it would depend on the impact on the environment as to whether this is a viable option
does not solve problem
I am in support of this option if Option 1.2 is not achievable.
Does this have a negative effect on fish and other sealife? If not, I think it's a good option
Destruction of sea grasses
Appears to be the most cost effective and have the lowest impact on beachgoers. What is the environmental impact on marine life?

Flexible, works with nature to maximize sand on beach.
Less environmental damage and less disruptive to people.
Better financial option.
This would be too high a price to pay for the environmental impact. The UN has stated that dredging is not sustainable and negatively impacts the environment.
Least disruption
Not disrupting activities and enjoyment and serenity of visiting the beach
There are many technical unknowns to this, and a large number of feasibility issues still to be investigated identified in technical report. Not sure of feasibility either of process, of quality of sand to be dredged, or for effect on seabed. Timescales for investigation would be significant, and no short term solution for the current problems at Henley Beach South has been identified.
Interference to sandbars and safety for swimming and beach goers. Environmental Impact Statement required.
damage to sea floor and sea grass and marine life
Effective, seems to have less impact on environment, beach goers, residents of nearby beaches. The process seems relatively short in comparison to more expensive options.
This option still seems invasive of the beach and shore
Seems to be lowest cost and lowest environmental footprint
Dredging will impact the sea bed and create a greater footprint of impact for these beach management activities. This is as opposed to continuing on-beach management activities.
minimal impact of residents of any suburb, easy and must be an economical method without having to pillage sand from beaches that are also losing sand but at a lower rate. (fact).
I did a school project on this exact issue and all the information I found said that the short term gratification (cheaper cost) of any dredging based proposal would not be worth the long-term environmental impacts and with all-likelihoods being we would eventually need to build the pipeline eventually anyway.
Impact on sea grasses and environment
Cheapest option, and does not disturb beachgoers or residents as much as other options.
While scuba diving I personally witnessed damage caused by turbidity, sedimentation and reef smothering at Port Noarlunga reef due to previous dredging that occurred at Port Stanvac. I am completely opposed to dredging in SA waters because of the environmental damage it causes to coastal, estuarine and marine ecosystems, including reefs, seagrass and benthic marine life. In addition, water quality is likely to be affected and could lead to environmental nuisance where swimming occurs. It will also potentially have an economic impact on tourism and local small business, especially diving companies.
Disruptive to beach and water users and to marine mammals and birds and fish. Disruptive to ocean floor and sea grass beds

Not the right solution
This runs the risk of damaging sea-grass beds whose health are part of the solution for sand-drift.
Environment Damage
It's the most sustainable solution and least obstructive to local beach users
Only the beach being replenished would be affected
Most sensible option less impact to beach goers
Least impact of the beach sand which is important to beach goes and least impact on residents. Sand levels at Grange are low
Less disturbance to onshore beaches
Need to watch sea grass affects
Collecting sand from near the shore is less desirable than option 1.2, however, this option is still preferable to other options, as it does not require an expensive and disruptive pipeline, and does not extract sand from the northern beaches themselves. Comprehensive environmental impact statement would be required for this option, and negative environmental impacts would need to be prevented or mitigated.
In understand that bulk sand movement deposits are further north suggesting that collection from northern areas might be more appropriate.
Sand off Largs Bay is likely to be approved by EPA with no testing of sand as I know of. Placing sand West of the West Beach surf break means no sand for the beaches and dunes for West Beach, South Henley or Henley Beach. The sand that is on the beach moves North when it is in the water, if this step is missed of placing sand on the beach you are just speeding up the sands northern movement and therefore achieving nothing for West Beach or Henley. With no mass fill onto the beach I can't see how we can get back to a 1970 beach standard which is the benchmark set by all governments.
Dredging would have a high impact on the coast. Unlikely that this proposal would receive EPA approval.
It is not known whether there is a suitable sand deposit available.
A floating pipeline would impact on West Beach boat ramp,
Depositing sand near the shore line would impact water quality.
It all ends up back in the water anyway
This is dredging sand from south of the breakwater which contains seagrass and probably shellfish beds
Cheapest, and little environmental harm
Not proven. Too many risks and unknowns. Is there adequate sustainable sand reserves. Will EPA allow it?
Seems like a reasonable and non0intrusve way to deal with sand top up

I do not see the point in pumping sand from near the shore although it will probably have the shortest pipeline while in operation and affect less coastal users.
There is no scientific evidence that an acceptable supply of sand is available currently and/or would be replenished once harvested.
Will keep trucks off the beach & stop the mining of beach sand
I have read the research.
This technique requires no heavy machinery on beaches, meaning less disruption for communities and beach users. It provides flexibility and uses nature to restore the beach profile, maximizing sand staying on beaches. It is one of the most economical and sustainable options in the face of sea level rise and climate change impacts. To ameliorate any impacts of dredging a range of environmental management activities including turbidity monitoring both pre-and post- dredging seagrass surveys will be undertaken. Environmental assessments will be conducted on source site and monitored by the EPA.
To get the sand pumping unit off the beach, and lowest cost
This is an option that is available for comment. However, there is another method/ option that I would prefer. If the sand was pumped via a pipeline from the northern beaches, for instance Grange beach, where sand build-up has created huge sand banks and sand hills thus making the swimming area shallow - you can now walk around the end of the Grange jetty at low tide.
Possible at 2km. EIS required
Unless sand is put back on to the beach cant see how will get back to 1970 level sand which I understood to be a Government benchmark
Can't be micro managed easily ... and would work out dearer in the long term .. with regard to deliverability, environmental carnage, a political / community dividerer and no sand as source without inevitable environmental marine decimation.
Damage to seagrasses and local species
This will be removing sand from the seabed, with a concomittant loss of marine life. I think there are better alternatives
Does not involve trucks and machinery on the beach, which is noisy, disruptive, potentially risky to pets and people, and causes pollution. Mounds of sand are also a little unsightly. The offshore distribution illustrated is a positive. Also reasonably cost effective option.Not the most preferred option as still have a dredging vessel.
From my research this is the most viable and most cost effective option
This would simply not solve the problem.
Permanent damage to seagrasses and ocean environment
Damage to habitat
This sounds like one of the better options since it will be minimal environmental impact on Semaphore and Largs beaches.

Environmental impact of changing the natural coastline
Damage to seabed and sealife
keeps trucks of the beach and doesnt remove any existing sand
I am worried about disturbance of the sea floor, and possible loss of sea grass. I also question the futility and ongoing expense of trying to intervene in a natural, dynamic system of Northerly sand drift. Houses at West Beach, Tennyson, Brighton and Somerton should never have been built on the sand dunes.
distance from shore not specified, no environmental impact studies
As long as in the area
Cost and does SA own a dredge or would it have to be purchased?
I am corned about the impact to our beach in Largs bay and to the marine life here. there is also a carbon emissions impact of the dredge going up and down the coast.
Economically a very good option and also less disruptive to beach users and the coast
Seems to have limited environmental impact.
no trucks or machinery on beach
It will not involve trucks or machines on our northern beaches or jetties. This will ensure that our sand and sand hills will not be vulnerable to more erosion that is already occurring due to rising sea level and storm activity. It is more economical. Environmental Impact Statement would be needed to be undertaken.
I think dredging is the best option for a number of reasons. 1. It is much less intrusive to the beach and residents.2. the sand can be deposited slightly off shore from the beach and to then accumulate on the beach with the current - my reading is that this will be more long lasting especially if we mine larger sized particles.3. it is much less expensive. 4. it is a much more adaptable and flexible system with the challenging and escalating climate change indicators (more storms, erosion, etc)
Possible at 2km offshore
Environmental impact statement required
I would support this if there were a suitable nearshore sand deposit in water deep enough for operation of a trailer suction dredge (as shown in the diagram) and if could be achieved without damage to the seagrass meadows. However I do not believe that a suitable sand deposit exists near the Adelaide shore.
Best way to manage sand drift. Capture and prevent sand entry to North Haven Marina
Dredging has environmental impacts such as biodiversity, water turbidity and noise impacts on marine mammals. Close to shore might be better and seems less invasive.
The disruption, cost and timing is desirable. There's no information about environmental impacts of any methods, so I would strongly support if there was an agreement that seagrass and other ocean life disturbance was minimal.

Does not specify how close to shore. Would disturb my use of beach for sail & kite surf club area
Sand gets moved with tides and storms
Possible at 2km offshore. Environmental impact statement required.
Environmental vandalism
Dredging needs to be carried out well offshore to ensure beach users are not affected. Support dependent on location of dredging - an environmental impact statement would be required to ensure there are no environmental or social impacts
To disruptive to the locals affected by the work scope
This is the most logical, practical and cost effect method. It will also be less disruptive to other beaches, environment and cause less damage to them. Semaphore has already lost too much sand, Redeliver sand that has washed out to sea and place it well back on the below tide mark where science has found produces the best results.
Dredging is an option but not he best option. Dredges operating continually detract from the natural beach environment.
I support this option however I would like to acknowledge that more work needs to be done to understand what the environmental impacts would be on the surrounding marine environment e.g. sea grasses. Strongly support with an Environmental Impact Statement
Putting deposited sand west of the surf break will not benefit West Beach to rebuild the sand on the dunes and the beach. Cannot see how it would obtain EPA approval and is not a realistic option. No idea how it is going to impact on the seabed and could end up being a disaster for the sea bed
What effect this will have on the Environment, our coastline will be effected.
It would take numerous rounds of dredgring & shifting the sand. There is no specific detail as to where the sand will be dredged from.
We do not want trucks on the beach, moving up and down our streets or a slurry at the end of our street.
Plus its the cheapest option.
I assume the beach in quesrion supplying this sand would be Semaphore, whose sand is totally unsuitable
Due to the environment concerns to due turbid and the effect on the sea grass, the storage of the dredge, lack of sand source, over Carbon footprint of running the dredge for 20 years.
Not sure whether there is sufficient sand there
This does not appear to be as damaging to the beaches at Semaphore, Largs, other northern beaches where the coastline is already receding and still not recovered from the sand removed a couple of years ago. Subject to an environmental impact assessment, this appears to be an ok option to minimise negative environmental, social and economic impacts.
Options 1.1, 1.2 and 1.3 look to be the least environmentally, socially and economically damaging overall of the options provided, as long as taken from far enough offshore.

This option will work. It will be least disruptive to beach-goers, beach users, will maximise sand retention according to placement, and will obviate the need for machinery on our beaches. It is also less polluting of the environment (sound, fuel, fumes, noise) and is way less expensive than other proposals.
Lower impact on beach environment -flora fauna environmental disruption and people's enjoyment and access. There is some buildup of sand closer to shore in certain areas
My overall preference is NOT to Dredge OR use a Pipeline - both are reactive solutions to the problem. My overall preference is to address the root cause of the issue (Climate change, Increasing Storms and Wave Movement) and create an artificial reef or breakwater ~1km offshore. Addressing the cause, not the symptoms is my strong preference.
Notwithstanding, I chose 'Strong Support' as this technique requires no heavy machinery on beaches, meaning less disruption for communities and beach users. It provides flexibility and uses nature to restore the beach profile, maximizing sand staying on beaches. It is one of the most economical and sustainable options in the face of sea level rise and climate change impacts. To ameliorate any impacts of dredging a range of environmental management activities including turbidity monitoring both pre-and post- dredging seagrass surveys will be undertaken. Environmental assessments will be conducted on source site and monitored by the EPA.
Meets the criteria of your review to not cause environmental harm
I have researched studied many options for sand management of beaches and have concluded that dredging whether near shore or offshore is the best option in terms of minimal environmental impact, value for money, least negative impact on community and safety whilst delivering the desired sand management outcomes.
Least disruptive to beach activities and cheapest option
This technique requires no heavy machinery on beaches, meaning less disruption for communities and beach users. This technique does not require major earthworks and road works, not only disrupting communities but possibly damaging properties, infrastructure, heritage structures and significant trees.It provides flexibility and uses nature to restore the beach profile, maximizing sand staying on beaches. It has the ability to build beaches and dunes, rather than lower them and put dunes at risk of collapse in the face of sea level rise and a higher frequency of storms. It is one of the most economical and sustainable options in the face of sea level rise and climate change impacts. To ameliorate any impacts of dredging a range of environmental management activities including turbidity monitoring both pre-and post- dredging seagrass surveys will be undertaken. Environmental assessments will be conducted on source site and monitored by the EPA. The technique has been trialled successfully both nationally and internationally and there are a number of small size Trailer Suction Hopper Dredges on the East Coast which are available to undertake the work. The cost of this option is such that it allows money in the SA budget to do other coastal restorations. If a cost/benefit analysis of this technique was undertaken, its high effectiveness in maximising sand staying on beaches, its lack of community and business disruption and its avoidance of environmental harm it would rank this technique as one of the most cost effective

options.This technique does not impact or disturb the historical and cultural landscape of the Kaurna people, the traditional owners of the Adelaide plains.
This solution as proposed currently does not ensure the long term permanent nourishment of the southern beaches and the potential risks and uncertainty associated with long term sand availability and opportunities for nourishment are considered significant.
Potential benefits
Ensures an immediate and large deposit of sand to West Beach and opportunity for the system to return to equilibrium
Minimises visual intrusion and disturbance for our community associated with permanent structures within the coastal environment
Provides opportunity for low frequency sand nourishment and equilibrium within the coastal environment
Would ensure appropriate sand volumes to protect assets and maintain beach widths
Minimises intrusion for the community within the northern beaches associated with sand trucking and heavy vehicles
Frequency of top ups would reduce the impact on our beach users, wildlife and our community
Opportunity for sand regeneration in other areas (such as Henley South and Joe's Kiosk) if required
Potential risks
Uncertainty around environmental damage associated with dredging (ecological, seagrass degradation, water quality)
Uncertainty of additional licenses and EPA approvals required and the long term security of these
Uncertainty of sand source location
No actual recent data has been collected to confirm if off shore locations or quantities of required sand are appropriate
This has the risk of creating stronger wave action onshore of the mined areas
The 4 year nourishment (maintenance contribution) of 360,000m3 is base don the afore mentioned annual loss of 90,000m3. As stated above this undervalues the loss by approx. 25,000m3 per annum meaning a net reduction of 100,000m3 over the 4 year cycle to Cell 3.
Just so something please! Stop endless reports, do something. This option appears to be most practical in terms of impact, time and cost. Only concern is the environmental impact of dredging.
I am concerned about disruption to artificial reefs, Seeds For Snapper bags and seeded oyster racks which have been placed offshore. Despite geolocation, these shift. Dredging would need to avoid these.
lower cost and doesn't erode semaphore and largs
The literature shows that this option will have a detrimental effect on erosion, sea grass growth, and benthic communities

It would depend how close to the shore. As dredging close to the water edge would disrupt beach sand
I believe dredging by the shore could block the use of sections of beach. I also believe it could be ugly and noisy. We do not go to the beach for ugly and noisy.
Flexible and will be able to target erosion hot spots
Fewer trucks on beaches
Less environmental harm
Less disruptive for communities, beach goers and beach ecosystems
Dredging is working further south. Seems preferable to digging up the beach (pipeline option) or trucking sand from north to south.
The sand pumped to near West Beach will be moved North without replenishing west beach
Don"t want trucks carting sand up and down the beach and ruining the beach, also dangerous when walking.
Environmental impact statement required.
It is my understanding that this is not a longterm solution.
Changing the level of the offshore floor has some significant effect on the tidal flow
Have suitable offshore sand sources been identified?
How does sand deposited near the shoreline end up on the beach?
It seems that approval from the government agencies is required for dredging to be undertaken.
Also dependent upon a suitable dredge being make available.
Might be a feasible idea but time for renewing Weat Beach and there appear to be too many variables to be sorted before this option can commence depositing sand at West Beach
Prefer the correct size grains used with least environmental impact that doesn't need a permanent pipeline and no trucking.
Impact to marine life
This technique requires no heavy machinery on beaches, meaning less disruption for communities and beach users. It provides flexibility and uses nature to restore the beach profile, maximizing sand staying on beaches. It is one of the most economical and sustainable options in the face of sea level rise and climate change impacts. To ameliorate any impacts of dredging a range of environmental management activities including turbidity monitoring both pre-and post- dredging seagrass surveys will be undertaken. Environmental assessments will be conducted on source site and monitored by the EPA.
Less disruptive
Damage to seabed and impact upon recreational fishing

There has been an acknowledged lack of meaningful data that supports a viable sand source for any dredging options. No scientific modelling has been done therefore there is uncertainly for the environmental impacts of dredging as well as the timing of implementation which would have further devastating affects on the central beaches already eroded and depleted of sand (West Beach, Henley South, Henley Beach). There is no certainty that the EPA would grant a licence to dredge so questionable that any dredging options proposed were even practical. Concerned that dredging and its impacts are "out of sight/out of mind" for the average person and hard to ensure that environmental damage is indeed not occurring.
Seems like the best option (cheaper and less impact to the beach). Would like to know how intrusive dredging is on sealife.
The sand is the right consistency, and it is already part of the system. It reduces the shallowness offshore, and protects the riprap wall most effectively. coarse sand from quarries changes beach profile detrimentally, and has proven disastrous in the past.
Beach sand needs to be managed. I am happy for the experts to determine the best way.
I'm inherently against dredging of the sea bed due inevitable siltation impacts on nearby benthic ecosystems.
Dredging would be detrimental for marine life.
I dont think it is viable. Where would we ever get the OK for this?
Also it is at the wym of Government.
Possible at 2km from the shore. Keeps trucks off beaches. Trucks and sand mining damage the fragile beach environment and prevent community use of the beach. An environmental impact statement required.
Ugly, not a long term solution
It can be rotated so don’t ruin only one part of marine environment can move on let it recover
Better to dredge further out into the gulf but if this becomes the option then it is better than options 2.1, 2.2 + 2.3
Upsets the sea grass which will stabilise the area which has recently been set up .
I think it will have less negative impacts if the dredging is further away from the shore.
Near the shore is the same as trucks.
People will be inconvenienced, plus the noise will again inconvenience,
Why even consider this as we have large sand deposits further offshore.
Minimising impact to beach users
Does nothing to reverse sand movement
Sand is deposited offshore before beginning to drift northwards
Studies of past identify no sand or lack of correct sand size required. I have been involved in these studies

The cheapest and most suitable way to save and improve the quality and endurance of our sand
This is natural sand drift which will be replaced in a short time.
Although effective and efficient, I am concerned about dredging up existing habitats and depositing silty sand mid water close to the beach
Avoids sand carting and pipeline flexible can supply other beaches as needed. Environmentally sound.
No machinery on beaches so less disruption to beach goers. Allows natural beach sand movement to maintain beach sand profiles. It is economical option.
Damages seagrass
Too much disruption to beach goers
Dredging is my preferred option, because it keeps trucks and sand planes off the beaches. I went to West Beach where there was one truck moving sand. The whole beach was churned up, like a ploughed paddock, and we had to scuttle out of the path of the truck, even though the driver was being vigilant. It would be impossible to go and use that beach, or even walk along it, under those conditions, so what would be the point of taking sand off the beaches, making them unusable, in order to fix up other beaches.
The sea grass has receded a long way, and with current storm water pouring straight out into the sea, it is unlikely to regenerate. Therefore, there is existing sand near the shore. Not ideal, but better than scaping the beaches.
I heard that the amount of money allocated to examine this project was $200,000. I doubt that there would be any private business, thinking about spending $50,000,000 plus on a project, that would allocate such a small amount to conduct feasibility study. With this low amount of money, how can proper feasibility studies be undertaken and reported? Without enough correct and reliable information, how can the best possible decisions be made? Guesswork is not good enough when determining the long-term management of beach sand. Listening to the loudest voices in the Adelaide community should not be the scientific reason for making a decision about the management of our beach sand.
Seems to have least disruption to beach users, as long as dredging is far enough offshore, and not as expensive as some other options.
This option keeps sand collection offshore, avoiding damage to beaches through collection by sand planes and trucks. It deposits sand in the nearshore where I believe it will be most effective in retaining sand for longer in areas where it is needed. It also provides good flexibility to be able to move the barge along the coast and deposit sand in areas of need as circumstances change. this is particularly important as we experience the effects of climate change on storm activity and sea level rise.
• I have a major concern that this as this is a desk top review only,
• There is no scientific modelling
• There is uncertainty regarding the impacts of dredging.

• Concerned that any environmental damage becomes “out of sight, out of mind” – Just because we can’t see the damage, doesn’t mean it doesn’t exist.
• No analysis for conditions specific to the Gulf St Vincent.
• This would also require approvals including but not limited to EPA and dredging licenses. This creates uncertainty and could add years to any implementations.
• Sand will be placed offshore, which does not provide West Beach with a sandy beach or promote dune growth.
Less impact on beach
Less environmental impact to shore & foreshore environment than the pipeline & carting options
Possible at 2km offshore. Environmental impact statement required.
1. Dredging does not ruin the beach, does not put trucks on the beach. Dredging can be used when other beaches require the sand; it does not require permanent, invasive infrastructure on the beaches. Dredging is far less expensive than other options and has far fewer negative impacts on beach users and nearby residents.
2. Semaphore/Largs/Taperoo beaches are used not only by nearby residents, but also by northern suburbs via the Expressway. these beaches are very family friendly, but will not be so with trucks and noisy infrastructure on them.
3. If this review supposedly considers the future of all Adelaide beaches, why have you not considered where the sand will come from when you take too much from Semaphore/Largs/Taperoo beaches?
If I have to support any option it would be this one as it is a floating pipeline with minimal disruption to our beaches.
No external sand source
Will create extreme ecosystem disruption
Sounds much better than a pipeline or trucks, subject to environmental impact assessment results.
I answered this way because we haven’t been shown an environmental impact study, we need more information on it.
Possible at 2km offshore. Environmental impact statement required.
The most acceptable option, still not ideal but other options would be catastrophic
Too disruptive to the ecosystem. Floating pipeline would be a deterrent to beach goers.
Most Flexible, Least Disruptive to Beach Amenity and Communities, Most Effective for Keeping Sand on Beaches, Most Economic Strategy
More flexible than pipeline or trucks on beach. Could be adjusted to ongoing requirements if desired. I'm don't know enough about the seabed to assess whether sand is best dredged closer to shore or further out in the gulf. Must take care not to damage seagrass meadows as these help to reduce tidal sand movement.

Dredging sand will make the water deeper. Semaphore is perfect for families with children learning to swim as it's not too deep and much easier to spot a shark in shallow water.
"Support" but not "strong support" due to concern that the near-shore dredging would damage the beach area and the habitat adjacent to it.
Need to protect the seagrass/shellfish beds.
This is a large amount of sand from a small area which only fixes erosion at West Beach
It has all the values of the dredge options (see further comments under Option 1.3)
It is flexible and can be used along the coast as needed.
However, the effectiveness of the monitoring of turbidity and the effects on seagrass & benthnic creatures will need close attention
Sand would go offshore and then wave action would ensure successful build up of beach. No micro plastics from a pipeline and no destruction of dunes and metrology beaches. Care needed to find sand in appropriate areas of the sea bed.
This option does not involve extraction of beach sand. Scientific reports show that beaches are receding all along the Adelaide metro coast. Furthermore, any dredging option shown to be environmentally viable (through Environmental Impact Statements) is superior to options requiring use of on-beach heavy machinery, or requiring construction of a land-based pipeline entailing the destruction of dunes and their ecosystems (and continued use of on-beach heavy machinery to load/unload the pipeline). Also, this option 1.1 is financially more attractive than options involving on-beach heavy machinery and/or pipeline.
Ruining beaches with heavy haulage gear closing areas down
Would limit impact on beaches. Environmental impact study required to ensure only appropriate sand is dredged and sensitive seagrass and other natural structures are not impacted
The only sustainable option
1. Provides a FLEXIBLE and ADAPTIVE management and whole-of-system approach to the management of Adelaide’s Beaches
2. The LOWEST CAPITAL COST option
3. EXCLUDES the need to construct, maintain and decommission an inflexible and costly pipeline from West Beach to Largs Bay and Semaphore and avoid carting.
4. MINIMIZES COMMUNITY IMPACTS on:
a) public safety (i.e., truck movements on beaches and in suburbs, excavations on beach and intertidal zone);
b) public amenity (i.e., noise, truck speed, beach closures and nuisance impacts);
c) the natural environment and coastal erosion (on the dune and beach environments and habitats and accelerated coastal erosion of the dunes);
d)local infrastructure

ADDS BENEFITS to
d) the local economy (i.e., role of beach, dunes and foreshore in visitor economy and supporting local business activity)
e) the role of the coast in identity of place (i.e., activation of beach and community activities in dunes and foreshore)
F) Works with nature and not against nature by allowing sand to be naturally distributed
G) External sand is needed to maintain shoreline position, providing a sustainable solution to all beaches.
Maybe if over 2km from shore, otherwise impact to shore too risky. Environmental impact Statement would be required for confirmation
Dredging will be the most flexible and the most efficient way to bring sand where it is needed today, starting at West Beach, and tomorrow, where number of other locations will need replenishment of sand as the intensity and frequency of storms increase.
Dredging is also the only way to bring sufficient sand to create a mass-nourishment (sand engine) and work with nature to slow down erosion as it has been done successfully in other part of Australia and other countries like the Netherlands.
It's important that an environmental assessment is conducted to identify and monitor the sand source and the dredging operation in order to limit the environmental impact on the seagrass and marine ecosystems.
A small barge is also a more flexible option
Little detail, will inevitably cause sand build up at Largs, North Haven area as this is new sand. This could damage the sea bed.
Ongoing costly short term solution
Dredging is not viable, the sand is not out there, you also won't be able to see what damage is being done.
It does not involve extraction of beach sand.
All beaches along Adelaide metro Coast are receding.
Financially more viable.
Does not involve destruction of sand dunes.
I am very nervous about impact on marine life
Environmental impact
It provides minimal disruption to residents and best outcomes for the beach
This method is damages the sea ecosystem, destroying seabed and creates silt in the water damaging the whole local ecology.
Any Dredging close to the shore is costly , environmentally destructive and infinitely ongoing if the breakwaters from semaphore and west beach are not removed.

No permanent impact to beach amenity. Provides flexibility to collect sand from multiple areas as appropriate. Utilises natural wave motion to deposit sand onto beach.
It does not impede the beach with large vehicles and noise
it has the best potential outcome with an expected lower environmental impact
NO trucks roaring up and down our beaches, no massive destruction of heavily used beach access areas ie beside Semaphore Jetty. This option will look after Semaphore South, Semaphore beaches into the future rather than sacrificing the health of our beaches to try and fix beaches further South. Semaphore beaches and dunes have been seriously damaged and impacted by taking the sand from those beaches and near the rock barrier, let alone the amenity and safe use of the beaches and water for locals. Least disruption to beach users, I really dislike the trucks roaring up and down the beach and know from experience it seriously compromises the safety of people who use the beach - particularly children and dogs. Makes good sense - economically, environmentally (utilises natural sand /beach replenishing process of sand washing onto the beach, has greater flexibility as a sustainable sand management option in the context of sea level rises and impacts of climate change. Ongoing monitoring and assessments of environmental impacts of dredging (including pre and post dredging) on source sites is critical.
Possible at 2km off shore. Environmental Impact Statement required
Uncertainty around environmental damage associated with dredging (ecological,
seagrass degrada on, water quality)
Uncertainty of addi onal licences and EPA approvals required and the long term
security of these
Uncertainty of sand source loca on
No actual recent data has been collected to confirm if off shore loca ons or
quan es of required sand are appropriate
- One of the most cost effective options
- minimises the impact for all beach users as it does not make the beach inaccessible for periods of time every year
- would expect the sand would be dredged considering least impact to the environment and our total SA coastline
Keeps trucks OFF all beaches and allows all beaches to be accessible maximum time
- Minimum impact to residents living in the surrounding areas of where the pipeline pumping stations are planned
Achieves the objectives of the review
• minimal disruption for communities,
• avoids environmental harm, and
• maximise sand staying on beaches by sourcing coarser more suitable sand as an option

Dredging
1. Provides a FLEXIBLE and ADAPTIVE management and whole-of-system approach to the management of Adelaide's Beaches
2. The LOWEST CAPITAL COST option
3. Excludes the need to construct, maintain and decommission an inflexible and costly pipeline from West Beach to Largs Bay and Semaphore and avoid carting.
4. MINIMIZES COMMUNITY IMPACTS on:
a) public safety (i.e., truck movements on beaches, excavations on beach and intertidal zone);
b) public amenity (i.e., noise, truck speed, beach closures and nuisance impacts);
c) the natural environment and coastal erosion (on the dune and beach environments and habitats and accelerated coastal erosion of the
dunes);
d)local infrastructure
ADDS BENEFITS to
d) the local economy (i.e., role of beach, dunes and foreshore in visitor economy and supporting local business activity)
e) the role of the coast in identity of place (i.e., activation of beach and community activities in dunes and foreshore)
F) Works with nature and not against nature by allowing sand to be naturally distributed
G) External sand is needed to maintain shoreline position, providing a sustainable solution to all beaches.
I believe this option will have the least impact to the environment and our total SA coastline.
There will be NO trucks on the beaches allowing all beaches to be accessible all year round.
Minimum impact to residents living in the surrounding areas of where the pipeline pumping stations are planned
Achieves the objectives of the review
• minimal disruption for communities
• avoids environmental harm
• this is the lowest cost of all of the options
• maximise sand staying on beaches by sourcing coarser more
suitable sand as an option
Minimises disruption to community and low relative cost
I see this option the least invasive.

Potential environmental seabed damage, damaging plumes along with lack no clear sand source. EPA approval highly unlikely
This technique requires no heavy machinery on beaches, meaning less disruption for communities and beach users. It provides flexibility and uses nature to restore the beach profile, maximizing sand staying on beaches. It is one of the most economical and sustainable options in the face of sea level rise and climate change impacts. To ameliorate any impacts of dredging a range of environmental management activities including turbidity monitoring both pre-and post- dredging seagrass surveys will be undertaken. Environmental assessments will be conducted on source site and monitored by the EPA.
Do not wish to see the risk of seabeds with this option and potentially increase storm damage.
Being an offshore system will minimise disruption on the beach
Prefer pipeline with Coastal Reefs
No Sand source identified
Impact of dredging, eg seagrass
This is not a long term solution. It can be easily defunded, leaving our beaches at risk
Because it is sensible. But it would need a comprehensive Environmental Impact Statement.
Not a permanent solution
The northern opposition has in previous years argued there is insufficient offshore sources of sand and now accept there is, to avoid the pipeline solution. The dredging solution is susceptible to successive governments to fail in their obligations to guarantee the follow up and undertake top ups.
Any volume of sand offshore at Largs is untested and I don't believe will ever be approved by EPA.
I've used the beach and waters at west beach for over 50yrs and can tell you any sand dropped west of the break will not improve the beach and dunes especially in the months discussed.
It's an offshore system, therefore it will be the least disruptive to all communities, from the source of the sand at Largs bay and Semaphore, and along the coast to West Beach.
it will keep beaches at the source of the sand, open and free from heavy machinery, which is important for the well being of all users, for the visitor economy, ie tourism and the reputation of the state.
It's avoids environmental harm to our dunes and flora and fauna, including the endangered plovers.
We understand there will be environmental studies on the borrow sites to monitor and maintain seagrass health.
Sand will be delivered near-shore-which is considered a more effective way of keeping sand staying on our beaches.
It will be flexible enabling the delivery of sand where needed, in response to technological advances in sand management systems and the dredging industry and in response to climate change.

It is the most cost effective. However we hope should sand be required from farther afield that funds will be made available. Adelaide's visitor economy is worth 4.9 billion in March 2023 and set to rise to 5.9 billion in 2025, so i believe it's worth spending money to have the least disruptive method in place.
too much damage to local beaches
Not enough sand to be dredged
I think that dredging has to be considered as an option, and my concern with this is the impact on the seabed in an area that is already vulnerable. I suggest that this requires some assessment to consider the impact, for example on sea grasses.
I do not support nearshore dredging, due the potential environmental and marine habitat damage.
Would expect strong environment protests and delays from many groups.
Method placing of sand at near foreshore also disturbs near shore environment.
Definitely not future Government/ change of government safe.
Because of information I have read from Save Our Shores (SOS)
Terrible to see what's happening at Glenelg with noise and beach fenced off for many months of the year. This seems to be a much better idea
This option indicates where the sand will be take from and hence, restricts it from being taken too close to the shore or where seagrass beds lie.
Very disruptive to beach visitors
The sand is too fine and will just float away again
Disturbance of sea floor ecology
Further erosion of sand along the northern beaches
No identified sand source. Impact on marine floor. Further unnecessarily delays the installation of Option 2.1 which is the only feasible option.
No sand source has been indetified. Impact environment .
2 kilometres off shore + environmental impact statement
No horrible pipeline. No damage to the dunes. No heavy machinery harvesting sand. No trucking
Less disruption, more flexible and lower cost.
Impact of machinery the shore. Disruption to sea grasses and local marine life
It is the most flexible, efficient and practical solution
According to those who has researched these options and been involved in this consultation, this is the least damaging option. However, I also think that planning should not be approved for new dwellings so close to sites that are being eroded, and more should be done to strengthen the dunes, to make the beaches resilient and to adapt to rising sea levels. Trucks on the beaches simply destroys and negates the hard work community and council does to achieve these goals, including

destroying the habitats of shore birds that are signposted. The trucks drive too fast, causing danger to beach users.
Advised by Tennyson Dunes Group
This option will interfere with the natural marine life and could be dagerous to the marine ecosystem and to people using the beach. I think there are better options
The dredging needs to be at least 2 km of the shore. Otherwise you'll make a death trap like you did at Semaphore South. That was a gorgeous beach, before sand dredging for West Beach. I think the tally is 2 lives lost and multiple near drownings as a result.
Minimal disruption to beach users

Please explain your level of support for Option 1.2 - Dredge using large offshore sand deposits

This is not a long term solution.
Again, the seabed is a living ecosystem and i would not support its damage
There would be less visual impact, but I am unclear on the environmental implications. In addition, this option has on-going emissions production from a boat powered by fossil fuel.
seems better being further out
This seems like an option that has a low cost and smallest level of inconvenience. The environmental impacts are not stated so my support is on the basis that seabed issues have been properly investigated. I think the ideal model may be a combination of options 1.1 and 1.2
As with 1.1
Humans cannot control natural processes but mess them up.
on data presented :
- Second lowest cost (Estimates are selection phase so little engineering completed to get to better than +/- 50%
- seemingly least environmental impact (questionable)
Support what ever is required to maintain a usable beach.

Loss of sea grasses. Loss of various living forms eg crabs What time of year will it occur. Winter can be very rough on water.
Option 2 whilst slightly more costly seemed to require less work than option 1
Reference to previous response
Minimal impact to the beach and to beach users but would take longer to transport.
Dredging is harmful to the ocean environment
Would need more information about environmental impacts
No impact on beach users and cheaper option. Safer & more efficient.
Not clear.
Same as near shore dredging, disrupts sea life and requires messy machinery
Limited infrastructure impact on the dunes - no need for permanent pipeline; avoids regular truck activity on the beach - keeps beaches open for longer; avoids disrupting seabed close to shore.
Least impact on beach users?
This is long term sand deposits, and assisting their movement onto the shore is beneficial. Unfortunately, sea level rise is allowing swells to get closer to the shore before they break, and then bring higher energy wave action which smashes into the dunes and undermines them before the energy of the wave is lost in natural processes which developed over the last 3,000years.
Best option
Could be sourced is not a definite
Must not impact recreation boat fishers
Good but not as good as close in dredging
The natural sand drift requires management and a range of solutions may be required.
Dredging is good option but prefer option 1
Irresponsible, carbon intensive , ineffective
Damage to sea grass? Stop trying to reinvent the wheel and act on 30 years of past reports with recommendations.
Non a preferred option as still causes nearshore impacts from discharge.
Expensive and not sustainable long term
See my response above.
More expensive
Significant disturbance to ocean bed and all the plants and animals that live there.
Sand sourcing further from shore so less effect on amenity (visual, noise), desirably sources coarser sand and has less effect on seagrasses, volumes required can be obtained in a shorter time period, capacity to use same infrastructure to source sand from multiple locations.

Only useful if aligned biological and engineering works are undertaken to reduce coastal erosion and reduce longshore sand movement.
Bad environmentally on transporting sand and sealing damage
Cheaper
Best and only real solution in the shortlist.
AS above
Efficient cost effective solution that avoids the incredible disturbance and noise of beach excavation.
as above but it does damage the sea grass
Not a long term fix
I have been inconvenienced by current sand carting and have witnessed destruction of the beach sand surface particularly between Semaphore and Largs Bay
Minimal impact on the beach and dune system. Removes trucks and machinery from the beach/sand.
More affordable.
Need further information on ecological effects of the dredging, seems preferable to near shore dredging although if dredging done near outer harbour breakwater and north haven entrance may be able to mitigate silting of channel
Another lower cost less invasive option
Worried this would effect the offshore and nearshore marine ecosystems
Environmental damage
I think it would provide sand with the least disruption to the beach goers, strong concerns about the damage it will cause to the sea bed and the surrounding marine life
Dredging is generally a bad idea. Dredging impacts marine organisms negatively through entrainment, habitat degradation, noise, remobilization of contaminants, sedimentation, and increases in suspended sediment concentrations.
This option may have less impact on community.
Hasn't this option investigated before in the previous government! Have we find the new offshore sand sources!
Natural sand drift runs south to north - makes sense to return the drifted sand to where it came from
The large volume of sand available.
Use of a trommel in line for seaweed removal before pumping south may be required.
The holes created by the extraction of sand may be beneficial to marine life endemic to the area.
It is returning sand to area from when it historically came.
The proposed dredging would be in areas that in all probability have continuation due to their proximity to shipping lanes, heavy industry (oil) and the Port River. This could be a possibly solution

but sand collection areas need to be free of contamination otherwise you will create a toxic beach situation. And another issue for future generations.
You need a lot more sand than would be available in the nearshore to start a sand engine and you need a sand engine to slow the rate of erosion. There are plenty of offshore sources available in the near vicinity that would still be cheap to dredge-barge with a suction hopper dredge, which, in most cases, would have fewer social and environmental impacts than and onshore sand-collection system. By placing a large amount of sand in the nearshore bar over long periods of time, you start to slow the rate of erosion and by working with nature to distribute the sand more evenly you stabilise the whole system, allowing seagrass and sand dunes to regenerate, which start to develop a positive feedback for slowing the rate of erosion further.
Dredging will deliver large amounts quickly
No evidence of sustainability / concern of available resources over decades to maintain this work
The Beach at Luckybay DC Franklin Harbour has been replenished by dredging sand and has been very successful.
The EPA differ in opinion to this method to Coastal Protection who supported sand replenishment in this way.
The dune of replenishment sand at Luckybay already has vegetation growing naturally on it.
Slow, expensive and weather dependent
Natural sea sand only.
Minimal disruption over 20 year period as no additional top ups required.
Doesn't affect beach goers as no trucks, etc.
Cost efficient.
There was not sufficient information in the discussion paper to make informed input. There was no assessment of environmental impact of options or carbon emissions impact. There was no long term system change options presented. There was no explanation of why other options were not assessed. The options represent status quo and are not suitable options.
It's better than mining the dunes and having large trucks on the beach carting sand. I am concerned about the impact on seagrass beds though.
Sand in gulf has washes off beaches and should be returned to nourish beaches Rather than taking sand off a beach.
I think taking sand from numerous areas is better than just one.
The seabed is also at risk and should not be destroyed..
Just shifting the problem to other communities and bioregions
Too disruptive to environment
As above
Only support at 2kms offshore, environmental impact statement required.

The sand at Largs Bay beach is fine and will not stick at West Beach. You cannot ruin my beach. Would also like to see an environmental impact statement on this proposal also
3km off shore apparently will work and not be too disruptive An environment impact report will be needed to see what the impacts will be (sea grass etc)
Same as above, however I do fear that those in charge are unaware of fish habitats that fisherman are aware of. Example is recreational fisherman having zones banned and blamed for snapper shortage when its the fault of long-lining professionals over catching. Some departments are clearly clueless and refuse feedback, treating at as a tick box exercise with an end result already decided.
Large scale dredging to keep major channels open and ports clear is going to happen anyway, so use the sand in other places if possible
Might have less impact on our shores
This option requires a special purpose dredge that would be dependent on availability globally
Cost
Disturbing the sea floor , destroying sea grass beds , killing live on the sea floor like crabs and fish .
Another sustainable resources
Sand needs to be a constant loop from North to South otherwise it's just a one way stream to Outer Harbour and beyond. Offshore deposits are a finite resource.
This will have very destructive impacts on marine life and habitat
Good economic and environmental option
Research and use of this system from other countries shows that this method is effective and it will also cause less harm and disturbances to the beach and close by residents.
Brings in fresh sand, as long as it is not too costly
Not enough detail. How would sand be dispersed?
Less risk of erosion of beaches.
No trucks.
Less risk to existing dunes.
Impact on seagrass needs to be assessed.
Too many unanswered questions. Depends how far off-shore and how much damage will be done to the sea bed.
Because we need a permanent solution to the large influx of sand deposited due to manmade structures built over the years to both the south and north of the beach. The sand area at Largs is growing significantly and the beach is receding.
Least disruption and damage to beaches where sand is being sourced. Also less expensive than some other options.
If sand has to be dredged this is a better option

As above. Consult with environmentalists who care for the environment not their bank accounts.
As above
What impact to marine life?
Replenishment needs coarse sand, the Adelaide coastline is a south to north drift with no replenishment from the southern end, by the time sand moves to Largs it has got a lot finer and is far more susceptible to offshore drift
This is the best option for the marine life and beach goers
Once again, why destroy a living offshore beach ecosystem to not even get anywhere near saving West Beach? Get quarry sand. Don't destroy the fragile Northern beaches because you've become fixated on one approach.
Again, sand taken from 2 kms offshore and possibly from large quantity of sand investigated at Port Stanvac
As above turbidity monitoring and sea grass surveys have been included
No trucks on any beaches must be a positive.
As with option 1.1 this has less impact on the beaches, dunes and safer for all beach goers. The sand can be delivered to other beaches if needed and the costing is a little more but still good. Also it is not having to be top up like option 1.1.
https://climate-adapt.eea.europa.eu/en/metadata/adaptation-options/groynes-breakwaters-and-artificial-reefs
Waste of resources, should be dredged closer to shore
Personally doesn't matter to me, but a lot of people seem concerned with being disturbed or having their picturesque views bothered intermittently by efforts to keep the environment healthy. Sound option.
Remove Adelaide shores groin
It si the 2nd cheapest option and has the least distubance beach users. The lng-term environmental effects of Option 1.1 vs 1.2 need to be assessed.
Short term solution only with disruption to beach users.
Not sure
Less intrusive
reduces impact on northern beaches, seems like a sustainable and local option to fix west beach woes,
Same as above
Concerned about enviro impact at the dredged and safety at local locations
Too bigger environment impact
see previous

Assume this is the mass dredge 20 year option.
Less harm to beach and environment
I do not support damage to the seabed.
This seems to be a sustainable and cost effective process and causes minimum impact to beach users and residents.
better than near shore but still not great
Encourage growth seagrass and avoid bringing/trucking sand from elsewhere. Original drift of sand to northern beaches would move the sand
As above
Less obtrusive than trucks on the beach
The proposed volume of 2.35million m3 of sand sourced off shore Largs Bay, Section Bank and Pt Stanvac is a total nonsense. The location of sand sources, quality of sand,- untested. Pt Stanvac sand suspended between clay layers, definitely cannot be accessed. EPA approval unlikely, untested. EIS unlikely, untested. Pacific Oyster Mortality Syndrome not resolved or tested. Total 'nonsense' as a genuine option. 2.35 million m3 therefore greatly improbable.
Sand would need to be mechanically moved onto the shore to reinstate the beach and dunes.
This option moves away from sand deposits close to shore that are providing a sand buffer again sea level rise. Dredging offshore is also dependant on sea grass beds.
Seabed damage potential
Similar to option 1 but cannot see a benefit of this option for the additional estimated costs
Not as good value, similar impact as near shore
There is merit in this idea, particularly if a site with lots of sand and less environmental importance can be identified. But it's a long pipeline that needs to be built and the comes with risks.
If you remove sand from Port Stanvac it causes problem for both Christies and O'Sullivans beaches. This has happened in past. You could end up destroying 2 beach to try and save one. not to say damage to ocean floor and sea grasses.
New oyster reef off o'sullivans beach what inpact will it have on it.
This seems the most logical option - accessing large offshore deposits that will last a significant period of time at not much more cost than option 1. Least impact and does not appear to need any sand carting. Also the least intrusive - 2km offshore you'd hardly see anything, if at all.
Minimal impact on beach environment and allows unrestricted pedestrian access. The sand carting over the last few years is very disruptive and destroys the beach scape.
The best option in my opinion - the least obtrusive for those SA residents wishing to use our Adelaide beaches. Again: I have witnessed and been effected by sand collected from our Largs and Semaphore beaches: beaches scraped bare to ugly puddles of salty water, trucks driving at dangerously high speeds and, in general our beach areas - commonly visited by many from the

Adelaide northern suburbs, and as far north as Elizabeth etc - made to appear industrial and extremely unappealing; a great advertisement for those wishing to enjoy our Adelaide beaches - summer or winter, there latter of which we enjoy most!
Anything but beaches scraped bare - including for the useless, bandaid proposal of a pipeline!
Offshore seems like less immediate impact to the beach
As above, the dredging option appears feasible, cost effective and potentially lower impact than other options. Vessel sizing and sand dredging locations should be optimised to balance cost, environmental impact and overall carbon footprint. A larger vessel operating for shorter periods may potentially have a lower carbon footprint than a smaller vessel operating for longer end be more efficient. This should be be evaluated as marine diesels are typically notoriously dirty polluters.
This would be OK if it still uses the dredge and floating pipeline - probably a combination of these two options would be good.
Sand Particles need to be of a large and dense quality in order to stay longest on the beaches. Lighter less dense sand will be easily washed away. The Netherlands and European research and experience of the use of dredging should be considered and used with the idea of dumping sand and dredging off shore. Damage to sea grass and the environment with dredging should be considered.
Which one of the above will have denser sand? Could you also consider dredging sand from the monty of the Murray where there will be less damage from off shore dredging? Sand has to be removed from the mouth why not transport it to the Adelaide Beaches? There is no environmental damage if you do that.
Negative impact on the ecosystems and sea life
read before message. it's like fixing cracked glass by cracking more glass
Again, not enough information. Would the sand even have the right grain size? It seems like outer Harbour sand is too small and would not stay on the beaches
Cost effective sensible flexible environmentally sound solution that has been proven to work.
Not a deliverable outcome
See above
The build up of sand at Largs North & North Haven Beach has built up significantly as sand naturally moves North. Moving this sand would assist in maintaining the entrances to North Haven & Outer Harbour.
Appropriate if larger quantities of sand are required . Least on-shore disruption to beach goers and noise pollution to nearby residents
Technically good idea but unlikely due to siltation.
I feel it is the least environmentally invasive option.
Similar to option 1.1
Too much sand build up at Largs North

Want to leave the sea as natural as possible, only revert to this if absolutely necessary.
As above except not to remove sand from the natural source of pt stanvac as this is where Marino rocks / Brighton gets it sand from and it then moves north
I strongly support this option. It is the least disruptive to beach goers, the beach, and dunes environment (ecosystems). I would like to know more about what kind of investigation and approvals are required and how these will impact this as an option?
If I could say this is my most preferred option I would. Like option 1.1 this solution meets all three requirements of minimal disruption for all communities, avoids environmental harm (with an EIS) and maximises sand staying on beaches because it would be coarser grain sand. It's clearly much cheaper than the sand pipeline destructive white elephant. So it's a no brainer that this and option 1.1 are the preferred options. Dredging and depositing sand on the near shore is happening around the world with much success including in Australia. It is flexible and would be responsive to hot spots of erosion along the whole coast not just West Beach.
least intrusive solution and safest solution for beach users
It is difficult to comment on this as previous Governments have been unable to find such a large amount of sand, i.e. 2.35 million m3. The quality of sand would have to be tested at Port Stanvac and the Pacific Oyster Mortality Syndrome has yet to be resolved in other areas. How would this very large amount of sand be transported to West Beach and off loaded?
Ibid
Similar to #9 answer, I hold some concerns regarding the sand site collection and environmental, marine and fisheries impacts. But as long as these are minimised this is my preferred option. I do not support the construction of a pipeline or the construction of pumping infrastructure, so a dredge with temporary pipeline to the deposit site is more logical
Again this sounds better than the other options but requires an Environment Impact Statement to confirm that it will not destroy vital seagrass beds or any other vital underwater systems or sea life.
Again I am not sure on the impact of environment
Possible at 2 km offshore. Environmental Impact Statement required
Y there so plenty of sand around Semaphore, Largs Bay etc
Damage to existing seabed
This activity will impact negatively on the West Beach coastal environment and the ability for our club to conduct its core business of sailing off of West Beach boat harbour when the dredge ship delivers its sand cargo.
This option will also have a negative environmental impact of the off shore sea floor - sea grass etc.
Why harvest sand from out to sea when the sand that's missing from West Beach and other areas is now clearly sitting on Largs Bay and Semaphore beaches?
Possible at 2 I'm offshore. Environmental Impact Statement required
Short term solution only

Same as above
This could be great for a mass fill to get the beach to the 1970 base level, but would need another method to maintain between the mass fills (if maintenance worked no need for another mass fill). We have been told in the past years Port Stanvac doesn't have the sand source as mainly clay and rocks with some sand in between (has this been tested). Section bank sand as we have been told has P.O.M.S. And wont get touched leaving not enough sand in any location. Again we want to reduce sand movement from the beach which will not happen if the wet dredge sand is placed in the water. It will continue to move North and achieve nothing.
Would need further information on environmental impact
if possible at 2 km offshore. environmental impact statement required.
Environmental concerns
This could be great for a mass fill to get the beach to the 1970 base level, but would need another method to maintain between the mass fills (if maintenance worked no need for another mass fill). We have been told in the past years Port Stanvac doesn't have the sand source as mainly clay and rocks with some sand in between (has this been tested). Section bank sand as we have been told has P.O.M.S. And wont get touched leaving not enough sand in any location. Again we want to reduce sand movement from the beach which will not happen if the wet dredge sand is placed in the water. It will continue to move North and achieve nothing.
Destruction of fishing grounds and sea grasses
This will destroy sea life and sea grass beds
there has been too much disturbance of the sea floor. the decline in abundance and frequency of seeing dolphins near the semaphore beach over the last decade is obvious and sad. originally coming from interstate, I cannot understand how South Australians seem to have no regard for the value of the unique permanent harbor dolphins in monetary or any other terms. the whole of Australia should know about these dolphins
See 9 above, Any dredging will disrupt the natural environment.
My understanding is that Port Stanvac is not viable (already previously ruled out as a suitable source of sand)
Has there been any confirmation of the suitability of the other locations ? Environmental impacts to seagrass beds & sealife habitats ? Further investigation will take tine that really we do not have.... sand is required NOW not later.... if investigations prove these are not viable then what ?? Back to another review ?? By then it may be too kate !!!
Need more beaches to be acessed with a 4wds
Environmental impact study carried out
Cost effective. Doesn't seem as intrusive with machinery on the beach
Less cost and infrastructure on the beach but am concerned about environmental impact on seabed
not such a noisy option for local beach front residents--

Same as option 1.1.
In addition to my answer in Q. 9, I need to know the environmental impacts of this option to make a real decision, but, it is more favourable than any of the other options that I can see based on the information (that is lacking information).
DEW has told us for the last twenty years that the quantities of sand needed do not exist in St Vincent's Gulf. They are the government agency who have continued to research this fact. We need action now.
I support this or the previous option or a combination.
Keeps Trucks off the beach
As long as it is at least 2km off shore and an environmental impact statement is done.
I do not want trucks or a pipe line on the beach.
Questionable viability
Yes
Not good environmental practice to disrupt the sea bed, will destroy sea grasses. Also requires approval, so this is not a given resolution
As above.
Do not think we should be disturbing the local seabed to this extent. Not convinced that there is adequate appropriate sand.
Theses are further away from national parks and have a larger space with sand bars
Dredging seems least invasive
This option would probably provide the most suitable sand grain size and perhaps be a more stable buffering solution. It's seems that operations every 4 years for dredging compared to yearly 4 or3 month campaigns is a much more effective solution.
See response to 1.1.
Sand is best collected from accumulation sites that are sufficiently distant from population centres and other human activity to avoid disruption. Corrective replenishment is best achieved through mass renourishment, which requires a solution of sufficient scale.
Sand characteristics will dictate the efficacy of the solution and determine frequency of top-up replenishment (large grain sizes are 'stickier' and less susceptible to erosion from weather events).
There are many sand accumulation sites throughout Gulf St Vincent (and extending to Kangaroo Island). Cost-benefit analysis is needed to evaluate the trade-off between distance of transport (cost and utilisation) against the volume and frequency of replenishment (sand quality).
No impact on shoreline
There will be less impact on my local beach. I support this option provided there is an environmental impact study done to ensure it will not be detrimental to the environment.

This technique requires no heavy machinery on beaches preserving beach amenity, provides total flexibility to where sand can be delivered, places the sand in the nearshore where it can be most effective in restoring beach profile equilibrium using natural forces and is sustainable with increasing sea level rise. It is also one of the most economic solutions.
This seems less disruptive but would like to this used see mass nourishment sand engine as an option
See previous response.
In line with the successful Dutch 'sand engine' model, mass nourishments require solutions that are epic in scale. Seaborne deposits with ample capacity and suitable grain size must be identified without delay. Any shortfall should be made up with quarry sand.
Only support if done at least 2km off shore AND after a favourable outcome from an official environmental impact statement
not sustainable
Subject to further investigation
Efficient and effective way to move large quantities of sand. Low impact on the beach. Low impact on beach users. Cost effective.
Scientifically proven and cost effective
Not environmentally sound, Expensive and depends on dredge availability
Concern re impacts on seabed and on the coastal system generally. This is not explained in the briefing paper.
Dredging sand is NOT an option due to destroying (smothering and choking) reef and seagrass habitat. Dirty water blocks sunlight and so kills seagrass. Thick silt cover kills healthy reef habitat.
We have already lost 80% of seagrass along metro Adelaide. Dredging would reverse the increase in reef and seagrass health
Seed for Snapper project - fishers
Waste water - Bolivar
Greenfeilds wetlands /recycles water
Shell reefs
As above for previous option, strongly opposed to sandcarting and pipeline, and the terrible impact they will have on our beaches and communities. Dredging is cheaper, deposits sand nearshore rather than directly on the beach, where it washes away very quickly (based on close observation of West Beach use of Semaphore and Largs sand). I have ticked strongly but assume that there is an environmental impact assessment (as per technical report), especially around sea grasses etc. Please note that Bird Island/Section Bank has been suggested many times before as a possible sand source (including 2019) and will face strong environmental opposition.
Keeps trucks off beaches and no harmful pipeline

Also an option this is not disruptive and this way the sand is not being taken from other beaches that are experiencing some erosion as well. However, has an environmental analysis been done do determine whether dredging in these deeper spots would be detrimental to sea life?
All options do not give sufficient attention to the environmental and micro-organism/micro-crustacean impacts of moving sand or adding quarry sand - i.e. actual and potential environmental impacts.
Minimal intervention in terms of timeframe.
No information on the environmental impacts or considerations were included in the discussion paper.
Same as above, impact on environment
Cost effective over time. Avoids having large machinery operating on suburban beaches which presents risks to beach visitors.
Environmentally friendlier
environmental impact statement required
No Sand taken from existing beaches
This could adversely effect marine life
Again what are the environmental impacts on area being dredged?
Possible at 2 km offshore . Environment impact Statement required.
As a second option as per favour for 1.1.
Dredging is the least intrusive and disruptive for those of us onshore. It is also less expensive than other options
As above
This would depend on the environmental impact study that would need to take place prior to operation.
The review does not consider the effect of dredging on the offshore environment
I dont know what lives in the sand 2kms off shore, what would be disturbed by this process
Possible to access larger volume of sand without damage to the sea bed environment at smaller deposits of shallower waters
This appears to be a reasonable option so long as it utilises deposits where extraction will not significantly disrupt the status quo and introduce other environmental impacts.
Most of the sand from Long shore drift has ended up at Larhs and North Haven
Again, what dredge can support this, it is unslightly and will not deliver the required amount of sand over the long term
Less disruption and disintegration of foreshore and less expensive

As a one off mass fill to get the beach to the 1970 base level this would work, but the beaches would require additional sand on an ongoing basis. As per prior answer we want to reduce sand movement from the beach which will not happen if the wet dredge sand is placed in the water. It will continue to move North and achieve nothing.
See response to 1.1. Sand is best collected from accumulation sites that are sufficiently distant from population centres and other human activity to avoid disruption. Corrective replenishment is best achieved through mass renourishment, which requires a solution of sufficient scale. Sand characteristics will dictate the efficacy of the solution and determine frequency of top-up replenishment (large grain sizes are 'stickier' and less susceptible to erosion from weather events). There are many sand accumulation sites throughout Gulf St Vincent (and extending to Kangaroo Island). Cost-benefit analysis is needed to evaluate the trade-off between distance of transport (cost and utilisation) against the volume and frequency of replenishment (sand quality).
I think the sand needs to be delivered to the beach, not (just) off the beach.
same as above
Most favourable to cause least beach impact, (subject to investigation/reporting)
A deposit outside the metro area could be feasible but I have been involved previously with efforts to find suitable offshore deposits and there are very limited deposits. The offshore deposit at Pt Stanvac when dredged on a large scale unexpectantly produced a significant turbidity plume that caused the EPA to carry out an investigation for environmental harm. Residual deposts left after the dredging have not been proved and this site cannot be relied on as a future source. The Section Banks north of Port Adelaide is the largest known deposit but it has been established that the loss of shelter due to sand removal could have significant environmental impact on the adjacent mangrove shoreline. Further this deposit appears to be within the Dolphin Sanctuary. There are detailed reports on Section Banks sand source.
Large offshore deposits are a good source of sand to replenish the depleted areas.
How will the sand be returned to shore using this option ? Not supportive of a floating pipeline - this is both impractical and will have a negative impact on how we can use all of our beaches!
As stated its a large deposit of sand which probably came from Westbeach/Henley, it isn't essential to have such a large deposit and over time the sand will drift back anyway, the fact it's a different council shouldn't be a factor
same answer as Q 9
Interfering with the environment will be a never ending waste of time, resources and money, which can be better directed by the Government into more productive areas such as Hospitals, Roads and Schools.
Damage that would be caused to the marine habitat
No impact on the beach area
- No trucks on beaches
- Flexible and adaptable

- Barge can dredge sand from a number of appropriate sources and deliver to anywhere there is erosion along the metropolitan coastline
- Possible offshore sand sources need an Environmental Impact study on possible impact to sea grasses and marine and bird life
- Cost effective
- Cost less than Options 2 and 3
- No mining of beaches required
- Much less community disruption compared to pipeline and trucking
- Will build beaches rather than lower them
- No beach is degraded to advantage another
- No environmental harm to dunes compared to the pipeline
- Has been proven to work well in other places in maximising sand staying on beaches
- Less ongoing intervention and maintenance
Minimal impact on residents beach users and amenities
Not in my location
Not good environmentally
As with my answer above, I am not in favour of dredging mainly due to the indiscriminate damage that is done to the sea floor and eco system.
Also support this particularly the sourcing of offshore deposits
Not preventative approach
Would keep truck off our beach
Cost
If you can legitimately find these deposits that do not disturb the marine ecosystem and do it in any month other the winter then I might support this. It will still create more damage than other options
Economical and doesn't impact beach or road use.
Dredging is harmful to the seabed and associated fish and grasses.
Most flexible of 3 options put forward. Least disruptive to beach amenity and communities, most effective in keeping sand on beaches, Most cost effective.
As above BUT only after a favourable Environmental Impact Statement supports it .
Minimal impact to beach users
Removes trucks from beaches, replenishes beaches with sand from environment, not quarried sand. Environmentally friendly
Environmental damage to seabed, seagrass, marine animals
- No trucks on beaches

- Flexible and adaptable
- Barge can dredge sand from a number of appropriate sources and deliver to anywhere there is erosion along the metropolitan coastline
- Possible offshore sand sources need an Environmental Impact study on possible impact to sea grasses and marine and bird life
- Cost less than Options 2 and 3
- No mining of beaches required
- Negligible community disruption
- Will build beaches rather than lower them
- No beach is degraded to advantage another
- No environmental harm to dunes
- Has been proven to work well in other places in maximising sand staying on beaches
- It's quick and painless. No intervention and maintenance regarding ongoing top ups
There needs to be a process involved to compact the sand once it arrives at West Beach. Otherwise, it will just be "swept" away continuously. This isn't a long term, ethical, sustainable solution
for all the reasons outlined in previous response. These options also don't rule out existing strategies to increase seagrass beds.
I would be concerned about the safety of sand coming from near the port river
Same as for option 1.1
This has not been researched and will delay the whole process
Subject to cost considerations
Better than carting by truck. Commitment to this option may accelerate technology in this area.
less disruption, reasonable cost
No trucks. Not much interruption. Good value for money
Same reply as Qu. 9
But don't dredge sand from Port Stanvac again! Last time Hallett Cove and other southern beaches lost huge amounts of sand as it moved to fill the hollow left at Port Stanvac.
As per 1.1 answer
Would erode the beaches here quicker
As above
The sand that has eroded from West Beach, Henley South and Henley Beach drifts to Semaphore and Largs Bay. It doesn't seem logic to dredge from the seabed and further impact the sea floor/ grasses etc, when there is a huge buildup of sand on the northern beaches, abovementioned.
This dredging will impact the West Beach coast environment when depositing the sand cargo.

No confirmed source of sand or EPA approval
Because it disrupts other beaches and creates problems in other areas
This option relies on claims of sand sources, which despite investigations by the Coast Protection Board and others from the 1970s have not revealed any practical deposit apart from the three areas cited, all of which have significant problems.
Dredging the deposit at Port Stanvac is problematic because of the silt entrained in the sand and shallow depth over clay and stones. The last operation using a trailing suction hopper dredge caused a turbidity plume from Maslins Beach to Outer Harbour, triggering an investigation by the EPA concerned about environmental damage to the nearby reef. It also caused considerable community concerns.
Dredging the deposit at Outer Harbour Section Banks is within a protection reserve, with considerable issues. It is also understood that the dredging in the Outer Harbour Channel caused sediment plumes affecting nearby seagrass beds,
Dredging offshore of North Haven to Largs Bay is within an area of no known significant sand deposits. On the basis of past investigations, the sand that is present is shallow (2 metres or less), fine grained with a high carbonate content rendering it uneconomic for beach replenishment because it would drift so much quicker than the native sand. See Report of the Review of the Management of Adelaide Metropolitan Beaches 1997, Technical Support Information (d) AND p26 section 31, which recommended against the replenishment method.
Generally, the further offshore one goes the sand becomes finer. Also, the offshore sand has a higher carbonate content. Fine sand and carbonate material are consequently unsuitable for beach replenishment because they drift up to four times faster than the native sand.
In the period 1957 to the mid 1970s, Adelaide Brighton Cement Co. searched the area for high carbonate sediment for cement making and found material with 70% to 90%. (See Strategy Review 2005 - 2025 p110) (See Technical Report Offshore Sand Sources Report 1984.)
The statement in the Option that the Review of 1997 stated "sand carting was an attractive approach" is not correct.
Seems more sensible to source the sand closer to the target beach. The timeline for this option also seems minimally disruptive to beach users. I am not clear if one large dump of sand and then apparently no follow-up in the short term will be sufficient to maintain West Beach sand levels.
impact study required, possible 2km offshore
Not proven option
Environmental concerns
Disruption and damage to sea grass and marine life.
Minimise interruption to beach users and swimmers. Environmental Statement required.
This is a good option ONLY if it stays well offshore
This is possible at >2km offshore only - but an environmental impact statement is required

appears to be an efficient method
Minimal disruption to foreshore but support subject to outcome of further investigation and approval
Disturbs seabed
Damage to sea bed and not enough sand to dredge.
as above for option 1.1
As option 1
I would need to see scientific proof of adequate reserves
Would like to have environmental impact report done but well offshore rather than close in for less beach impact.
Possible at 2km offshore. Environmental impact statement required
Not sure if this would impact sea creatures living on the sea bed?
Damage the sea bed
it would depend on the impact this would have on the environment. There is insufficient information at this time
does not solve problem
It is my belief that this option will provide the best balance between the work required and the usage of the beaches. I understand that there is a cost associated with it but so is with everything, it depends whether its monetary or as other forms.
This option seems to have the least impact on the usage of the beaches and also uses sand dredged from existing deposits and not introducing new sand from external sources that may impact the feel, look and functionality of our beaches. I am confident that in the process of researching the options there was consideration of the risks but still, minimizing it is good.
This option also eliminates the infrastructure required from other options, line pipelines, pumps, truck, etc. These add complexity and introduce other factors like public safety, noise, pollution, and destruction of the existing habitats, etc.
Depends on effect on marine life
Don’t costs or seabed damage
Slightly higher cost than option 1.1
See above
Negative impact on the marine environment.
Least disruption
I support off shore dredging but the sand needs to be of appropriate grain size to make a difference to the beaches
As with previous option, there are a large number of feasibility issues still to be addressed which would effect timescales, with no short term solution identifed for the problems at Henley Beach

South. In addition no mention is made of previous studies which have outlined problems of sand quality in these large offshore deposits, particularly Port Stanvac, or to concerns about re-establishing seagrass beds to provide long term protection to the coast. If further feasibility work repeated these results, there would be yet more delays.
Only support is for possible 2 km offshore dredging. Environmental Impact Statement required.
as per previous answer
As above.
This seems a cheaper less invasive option
Whilst slightly more expensive I think this is a better solution
This will cause damage to Largs beach. Sand should be brought in from elsewhere to fix West beach.
I did a school project on this exact issue and all the information I found said that the short term gratification (cheaper cost) of any dredging based proposal would not be worth the long-term environmental impacts and with all-likelihoods being we would eventually need to build the pipeline eventually anyway.
Uncertain quality of sand and impact on environment
While scuba diving I personally witnessed damage caused by turbidity, sedimentation and reef smothering at Port Noarlunga reef due to previous dredging that occurred at Port Stanvac. I am completely opposed to dredging in SA waters because of the environmental damage it causes to coastal, estuarine and marine ecosystems, including reefs, seagrass and benthic marine life. In addition, water quality is likely to be affected and could lead to environmental nuisance where swimming occurs. It will also potentially have an economic impact on tourism and local small business, especially diving companies.
It is not clear what ling term effect this will have on the sand migration and sea bed
It has been done elsewhere without detrimental consequences and may also bring nutrients to the area
Not the right solution
Less damage to sea-grass.
Environmental damage
Support is based on a favorable EIS
Only the beach being replenished would be affected and dredge would be far from the beaches
As above
Best result for getting better courser sand. beach coastline sand is not sustainable as it is too fine and wont stay in place
No disturbances of beaches or costly alternatives
Need to monitor sea grasses and fish stocks

This is preferable to other options, as it does not require an expensive and disruptive pipeline, and does not extract sand from the northern beaches themselves. Comprehensive environmental impact statement would be required for this option, and negative environmental impacts would need to be prevented or mitigated.
I understand that the volume of sand required to replenish the area is extremely high suggesting that collection from further out or further north might be necessary. I suspect that the solution would not be a one off and would be part of an ongoing programme.
This could be great for a mass fill to get the beach to the 1970 base level, but would need another method to maintain between the mass fills (if maintainenance worked no need for another mass fill). We have been told in the past years Port Stanvac doesn't have the sand source as mainly clay and rocks with some sand in between (has this been tested). Section bank sand as we have been told has P.O.M.S. And wont get touched leaving not enough sand in any location. Again we want to reduce sand movement from the beach which will not happen if the wet dredge sand is placed in the water. It will continue to move North and achieve nothing.
Dredging would have a high impact on the coast. Unlikely that this proposal would receive EPA approval.
It is not known whether there is a suitable sand deposit available. Port Stanvac is not suitable.
What happens after sand is dredged? Not sufficient information on this proposal.
Probably further away from shore is better
This involves dredging the "Section Banks and surrounds" . Dredging here is likely to cause environmental damage to migratory shorebird feeding areas. The odds of approval are reduced by three investigatory reports resulting in the curtailing it as an option previously
Second cheapest
Not proven. Too many risks and unknowns. Is there adequate sustainable sand reserves. Will EPA allow it?
This makes more sense from a sand sourcing perspective but will probably be more expensive and will likely inconvenience more coastal users. But worth considering if an environmental/engineering solution cannot be found.
As per comments in Option1.1, but this would also be unsustainable, expensive and possibly environmentally detrimental.
No trucks involved
I have read the research.
This technique requires no heavy machinery on beaches, meaning less disruption for communities and beach users. It provides flexibility and can adapt to changing erosion hot spots. It is the best option for maximizing sand staying on the beach. It is the least environmentally harmful and has the ability to restore the beach profile while increasing biodiversity. It is also one of the most economical, sustainable and protective options in the face of sea level rise and climate change impacts. To ameliorate any impacts of dredging a range of environmental management activities including

turbidity monitoring pre-and post- dredging seagrass surveys will be undertaken. Environmental assessments will be conducted on source site and monitored by the EPA.
To get the sand pumping unit off the beach
This is an option that is available for comment. However, there is another method/ option that I would prefer. If the sand was pumped via a pipeline from the northern beaches, for instance Grange beach, where sand build-up has created huge sand banks and sand hills thus making the swimming area shallow - you can now walk around the end of the Grange jetty at low tide.
Possible at 2km. EIS required. Why is Largs Bay being picked on?
Can't be micro managed easily ... and would work out dearer in the long term .. with regard to deliverability, environmental carnage, a political / community dividerer and no sand as source without inevitable environmental marine decimation.Next best option
This is slightly better than near-shore dredging, especially if the dredging would occur anyway. However, there is a potential for contamination (e.g. from antifouling paint, chemicals, etc)
Similar views to 1.1 Does not involve trucks and machinery on the beach, which is noisy, disruptive, potentially risky to pets and people, and causes pollution. Mounds of sand are also a little unsightly. The offshore distribution illustrated is a positive. Also reasonably cost effective option. Not the most preferred option as still have a dredging vessel.
This is better than dredging nearby sand, yet not solving the problem and it is shallowing the seabed.
Damage to habitat
This sounds like one of the better options since it will be minimal environmental impact on Semaphore and Largs beaches.
As it changes the natural coastline
It will change sand deposits at other unrelated beaches.
I am worried about disturbance of the sea floor, and possible loss of sea grass. I also question the futility and ongoing expense of trying to intervene in a natural, dynamic system of Northerly sand drift. Houses at West Beach, Tennyson, Brighton and Somerton should never have been built on the sand dunes.
no environmental impact studies
As long as it's in the area of where the sand is missing, not to go Disturbed, another area down south or further north
Cost and does SA own a dredge or would it have to be purchased?
This seems like the most sensible option.
Economically a very good option and environmentally a good ongoing solution to an ongoing problem
Seems like a good idea, subject to understanding the environmental impact

least disruption to beach
This will involve us having not having endure trucks and machines on our beaches. It also spreads the sand sourcing load to ensure that our local seabeds and seagrasses are not impacted. It will not involve trucks or machines on our northern beaches or jetties. This will ensure that our sand and sand hills will not be vulnerable to more erosion that is already occurring due to rising sea level and storm activity. It is more economical. Environmental Impact Statement would be needed to be undertaken.
I think dredging is the best option for a number of reasons. 1. It is much less intrusive to the beach and residents.2. the sand can be deposited slightly off shore from the beach and to then accumulate on the beach with the current - my reading is that this will be more long lasting especially if we mine larger sized particles.3. it is much less expensive. 4. it is a much more adaptable and flexible system with the challenging and escalating climate change indicators (more storms, erosion, etc)
Possible at 2km offshore
Environmental impact statement required
This is too hypothetical to consider unless suitable offshore sand deposits can be found. At the time of my involvement in previous studies, no suitable deposits had been found (despite significant investigations) and I am not aware of any useable deposits having been found since. The exception here is the Port Stanvac deposit which has now been exhausted. The possible sources referred to in the present review have previously been shown not to be suitable. However, if sandy beaches are to be retained in the longer term, a suitable offshore sand would be a better option than trucking washed sand from on-shore quarries. A distant source, possibly outside the Gulf, might need to be considered, but the costs would most likely be prohibitive.
Less likely to manage inshore sand drift
See previous
No info in environment impact
Believe would be least disturbance to beach use & reduce beach reduction
Deeper weed beds may be damaged
Possible at 2km offshore. Environmental impact statement required.
Environmental vandalism
As above, EIS required.
Would prefer dredging occurred at more ‘industrial’ locations away from recreational beaches (eg Port Stanvac or Outer Habour) to minimise potential impacts
To disruptive to the locals affected by the work scope
Better alternative to sand pumping and carting as the the damage to the environment is less and more cost effective
See above comment re dredging.

I support this option however I would like to acknowledge that more work needs to be done to understand what the environmental impacts would be on the surrounding marine environment e.g. sea grasses. Strongly support with an Environmental Impact Statement
The quality of the sand proposed to be dredged has not been tested. There is some doubt if any sand from Pt Stanvac would be suitable due to the layers of sand being between clay layers. The volumes proposed would not be achieved and is another option that the EPA wouldn't approve. No guarantees that any sand would be sufficient to cover the volumes of sand required in the long term
Damage this will be done on the beach shoreline.
What will the impact be on the arranged that sand is being dredged from?
As for Option 1.1
If Largs Bay were not included, maybe
Due to the environment concerns to due turbid and the effect on the sea grass, the storage of the dredge, lack of sand source, over Carbon footprint of running the dredge for 20 years.
If suitable sand deposits are found, this might be feasible.
This option appears to be the least disruptive to the coastline (environmental and social impacts), and is more cost effective than pipeline and carting options. It avoids the need to destroy Semaphore and Largs Bay dunes by removing sand from there - sand that is not actually surplus to needs i.e. the sand is not building up there so it cannot sustainably be taken from there. Offshore dredging from large offshore deposits appears the best option all-round.
Options 1.1, 1.2 and 1.3 look to be the least environmentally, socially and economically damaging overall of the options provided.
This option requires no heavy equipment on beaches, thus not disruptive to those who simply want to enjoy the amenity. It is a flexible option which allows it to be responsive to changing circumstances. It is also less of a burden on taxpayers.
Lower impact on beach environment -flora fauna environmental disruption and people's enjoyment and access. Comparatively lower cost.
My overall preference is NOT to Dredge OR use a Pipeline - both are reactive solutions to the problem. My overall preference is to address the root cause of the issue (Climate change, Increasing Storms and Wave Movement) and create an artificial reef or breakwater ~1km offshore. Addressing the cause, not the symptoms is my strong preference.
Notwithstanding, I chose 'Strong Support' as this technique requires no heavy machinery on beaches, meaning less disruption for communities and beach users. It provides flexibility and can adapt to changing erosion hot spots. It is the best option for maximizing sand staying on the beach. It is the least environmentally harmful and has the ability to restore the beach profile while increasing biodiversity. It is also one of the most economical, sustainable and protective options in the face of sea level rise and climate change impacts. To ameliorate any impacts of dredging a range of environmental management activities including turbidity monitoring pre-and post- dredging

seagrass surveys will be undertaken. Environmental assessments will be conducted on source site and monitored by the EPA.
This is my preferred option because it uses offshore deposits rather than interfering with the northern beach sand. I believe that past dredging has caused a lot of seagrass damage and if this option is the preferred, I would like to see funding and effort going into choosing an operator with a better track record of causing less damage to seagrass and to put more effort (beyond the Ozfish volunteer initiative) to plant seagrass meadows offshore.
I have researched studied many options for sand management of beaches and have concluded that dredging whether near shore or offshore is the best option in terms of minimal environmental impact, value for money, least negative impact on community and safety whilst delivering the desired sand management outcomes.
Least disruptive to beach activities and less environmental impact on nearby waters with minimal increase in estimated annual cost from option 1.1
This technique requires no heavy machinery on beaches, meaning less disruption for communities and beach users. his technique does not require major earthworks and road works, which will not only disrupt communities but possibly cause damage to properties, infrastructure, heritage structures and significant trees. The technique provides flexibility and can adapt to changing erosion hot spots along the Adelaide coastline. Along with the other dredge options due to their flexibility, It is the best option for maximizing sand staying on the beach. It is the least environmentally harmful and has the ability to restore the beach profile while increasing biodiversity, as has been found to occur in other similar international trials. To ameliorate any impacts of dredging, a range of environmental management activities including turbidity monitoring pre-and post- dredging seagrass surveys will be undertaken. Environmental assessments will be conducted on source site and monitored by the EPA. It is also one of the most economical, sustainable and protective options in the face of sea level rise, high tides and more frequent storms. Due the relative low cost of this technique will allow money to be spent on other South Australian coasts needing support. If a cost/benefit analysis of this technique was undertaken, its high effectiveness in maximising sand staying on beaches, its lack of community and business disruption and its avoidance of environmental harm it would rank this technique as one of the most cost effective options. This technique also does not disturb or impact the historical and cultural landscape of the Kaurna people, the traditional owners of the Adelaide Plains.
This solution as proposed currently does not ensure the long term permanent nourishment of the southern beaches and the potential risks and uncertainty associated with long term sand availability and opportunities for nourishment are considered significant. This option should also include a pipeline to enable regular maintenance of the sand supply using the pipeline to distribute the sand most accurately to areas in need giving a flexible and controllable solution.
Potential benefits
Minimises visual intrusion and disturbance for our community associated with permanent structures within the coastal environment
Provides opportunity for sand nourishment and equilibrium within the coastal environment

Could ensure appropriate sand volumes to protect assets and maintain beach widths
Minimises intrusion for the community within the northern beaches associated with sand trucking and heavy vehicles
Upfront works completed over the initial period would reduce ongoing management impacts
The sand would also benefit beaches as it moves towards the northern beaches
Potential risks
Uncertainty around environmental damage associated with dredging (ecological, seagrass degradation, water quality)
Uncertainty of additional dredging licenses and EPA approvals required and the long term security of these
Uncertainty of sand source location
No actual recent data has been collected to confirm if off shore locations or quantities of required sand are appropriate
Impacts could be experienced within the Torrens outlet as a result of the sand volumes
Uncertainty of approach proposed beyond 20 year time frame (could be a short term solution)
Uncertainty of the up shore impacts as a result of excessive sand accumulation and the impacts this would have on the Semaphore and Largs Bay beaches
Just so something please! Stop endless reports, do something. This option appears to be most practical in terms of impact, time and cost. Only concern is the environmental impact of dredging.
The science of wave motions needs to be clear so that it doesn't cause unexpected consequences.
lower cost and doesn't erode semaphore and largs
I would support this subject to an environmental impact statement and the distance off shore - minimum 2km. This option seems like it would be the least detrimental to dunes and beaches
I believe this to be the best, less intrusive and safest option.
Flexible and will be able to target erosion hot spots
Fewer trucks on beaches
Less environmental harm
Less disruptive for communities, beach goers and beach ecosystems
would need testing to make sure the distance will work and the sand is suitable and assess ecological damage to seabed
The sand pumped to near West Beach will be moved North without replenishing west beach
Environmental impact statement required.
see above comment in 1.1
Please refer to above comments. Also no mention of ongoing top-ups

Same as answer to number 9.
Impact to marine life
If sand has to be shifted, this way is preferable to trucks collecting and carting it from the beaches
This technique requires no heavy machinery on beaches, meaning less disruption for communities and beach users. It provides flexibility and can adapt to changing erosion hot spots. It is the best option for maximizing sand staying on the beach. It is the least environmentally harmful and has the ability to restore the beach profile while increasing biodiversity. It is also one of the most economical, sustainable and protective options in the face of sea level rise and climate change impacts. To ameliorate any impacts of dredging a range of environmental management activities including turbidity monitoring pre-and post- dredging seagrass surveys will be undertaken. Environmental assessments will be conducted on source site and monitored by the EPA.
Less disruptive
Impact upon sea bed and recreational fishing
There has been an acknowledged lack of meaningful data that supports a viable sand source for any dredging options. No scientific modelling has been done therefore there is uncertainly for the environmental impacts of dredging as well as the timing of implementation which would have further devastating affects on the central beaches already eroded and depleted of sand (West Beach, Henley South, Henley Beach). There is no certainty that the EPA would grant a licence to dredge so questionable that any dredging options proposed were even practical. Concerned that dredging and its impacts are "out of sight/out of mind" for the average person and hard to ensure that environmental damage is indeed not occurring.
In addition, DEW's 2020 report concluded that Port Stanvac is not considered a viable source of sand as sediments are not suitable or adequate to replenish West Beach. Other sand sources sited (i.e. Section Bank) has POMS which means it is not viable for use in the immediate future. Other potentil sand sources (i.e. Largs Bay) have lack of data and has yet to be properly assessed and analysed. This uncertainly means that 1) it might not even be practical or 2) may add years to the implementation - time that the central beaches do not have.
Avoids damage associated with pipeline, disruption and dangers of trucks, does not involve leaving infrastructure vulnerable to extreme climate events and sea level rise, allows for complementary measures to retain sand on beaches such as geo textile parallel groins etc. However the data presented in the options paper is inadequate to draw robust conclusions from. Unclear as to how other options were excluded from the long list. Inadequate and disappointing process that appears to be designed to split coastal communities.
Similar to previous answer. Seems like a good idea if environmentally sound.
These deposits or simply the natural deposition point for sand already within the littoral drift system, so this is perfect from an environmental perspective
Beach sand needs to be managed. I am happy for the experts to determine the best way.
As per 9 above, but worse due larger scale.

Dreading is detrimental for marine life.
As above, this is not thought through. This dredging is a decoy to the real answer
If sand is required at beaches this is the ONLY option I would support .
Same as above.
See above
It has the least impact on the extremely fragile dune and eco systems
Once again upset the sea grass which has been set up to stabilise the seabed
I think this will have among the least negative impacts of all the options (for the environment and the community and tourism/local businesses)
To me this is the logical answer.
No trucks, no pumps, but west beach hits the sand it wants.
Minimises impact on beach users
Damage to sea bed. Not likely to get approvals
As a means of returning sand southwards
Seismic n coring have provided Intel sands required are not a resource going back to late 1990s n 2020
Other options are more suitable
Sea floor destruction and harm to the natural seafloor and habitat.
Although effective and efficient, I am concerned about dredging up existing habitats and depositing silty sand mid water close to the beach
It does depend on further investigation dredging must not disturb seagrass and generally be environmentally sound.
Same as option 1.1 but not quite as economical.
Damages seagrass and habitat
Best option minimal impact and will stop further erosion and stops trucking ruining and creating further damage to our beach . The damage to sand dunes and dangerous state that beach is Jeff in via current trucking will stop
This is my preferred option of all, because it is the least obtrusive.
There have been studies done about all of the creatures that live in the sand. Has anybody looked at that? If you take a park, and scrape off all the living plants and animals, you would be left with a wasteland, with maybe weeds, that nobody would go to visit. Nobody sits on the great swathe of sand that has been imported onto West Beach. If you scrape the beaches of the top layer of sand, you effectively create a desert, and it would feel, instinctively, like dead beach. No-one would want to sit there.

I was appalled to hear that if there were a pipeline, it would be buried through the dunes and under the footpath. What a nonsense. We have spent decades planting out the dunes, to provide habitat and to hold and build up the sand, and I am aghast that someone suggested just digging through the dunes. It, to me, is a very ill-thought out idea.
There are massive dumping grounds of sand further out, that would be ideal as a sand source. The sand is already there, could easily be harvested and moved to where its needed, offering flexibility.
Needs to be offshore far enough to have minimal impact on beach users, and of course the environmental impact on seabed out around dredge sites considered and managed.
This option keeps sand collection offshore, avoiding damage to beaches through collection by sand planes and trucks. It deposits sand in the nearshore where I believe it will be most effective in retaining sand for longer in areas where it is needed. It also provides good flexibility to be able to move the barge along the coast and deposit sand in areas of need as circumstances change. this is particularly important as we experience the effects of climate change on storm activity and sea level rise.
• Desk Top review only
• Lack of identifiable sand sources.
• No time frames for identifying a sand source and subsequent modelling and analysis.
• Whilst this may be viable in other parts of the world, no modelling or analysis specific to the Adelaide coastline and Gulf St Vincent has been conducted.
• If a sand source is identified the necessary studies, analysis, modelling and approvals could add years to any implementations.
• We have been consistently advised that Pt Stanvac is unsuitable – in 2020 a DEW report stated The DEW report stated that:
"Based on the analysis of potential dredging risks and the properties of the sand that could be delivered to west beach the department has concluded the at the Pt Stanvac sediments are not suitable or adequate for replenishment at West Beach".
• Section Bank has POMS making it unusable in the immediate future.
• Deposits in Largs Bay have yet to be determined and analysed.
• There is uncertainty regarding the impacts of dredging.
• Concerned that any environmental damage becomes “out of sight, out of mind” – Just because we can’t see the damage, doesn’t mean it doesn’t exist.
• Sand will be placed offshore, which does not provide West Beach with a sandy beach or promote dune growth.
Perceived (pending environmental assessments) least impact on shore & foreshore environments
Possible at 2km offshore. Environmental impact statement required.

In addition to the above justification for dredging over any form of pipeline/sand carting, using large deposits farther from shore would be the preferred dredging option. Dredging already is occurring there, and sand from Port Stanvac has already been used as source sand.
1. Dredging does not ruin the beach, does not put trucks on the beach. Dredging can be used when other beaches require the sand; it does not require permanent, invasive infrastructure on the beaches. Dredging is far less expensive than other options and has far fewer negative impacts on beach users and nearby residents.
2. Semaphore/Largs/Taperoo beaches are used not only by nearby residents, but also by northern suburbs via the Expressway. these beaches are very family friendly, but will not be so with trucks and noisy infrastructure on them.
3. If this review supposedly considers the future of all Adelaide beaches, why have you not considered where the sand will come from when you take too much from Semaphore/Largs/Taperoo beaches?
Includes import of externally sourced sand
Cost effective
Less environmentally disruptive but needs environmental impact statement for each proposed site. Need to ensure endangered sea grass bees are not disturbed.
Because I do not want 80 trucks go past and back year after year past my home.
Sounds much better than a pipeline or trucks, subject to environmental impact assessment results.
This appears to be the better of the 3 options but again there has not been an environmental impact study released
Possible at 2km offshore. Environmental impact statement required.
Most Flexible, Least Disruptive to Beach Amenity and Communities, Most Effective for Keeping Sand on Beaches, Most Economic Strategy
Same as my answer to #9, ie.More flexible than pipeline or trucks on beach. Could be adjusted to ongoing requirements if desired. I'm don't know enough about the seabed to assess whether sand is best dredged closer to shore or further out in the gulf. Must take care not to damage seagrass meadows as these help to reduce tidal sand movement.
The marine life should be left undisturbed, we need to protect them and just let nature be.
However if humans desperately need to put their needs ahead dredging has proven to be less damaging than a pipeline.
I said for option 1.1 ""Support" but not "strong support" due to concern that the near-shore dredging would damage the beach area and the habitat adjacent to it", and I hope that suitable studies have been done to ascertain that the farther out the dredging would take place, the lower the risk to the beach and its habitat.
However, I'm mindful that ANY dredging would change that area's habitat, but am hoping a larger area would be somewhat more resilient to the dredging.

Unclear where this sand is being sourced and what environmental damage will be done
It has all the values of the dredge options (see further comments under Option 1.3)
The larger offshore deposits suggest a potential longer term effect that option 1.1
However, the success of this option for the long term requires an adequate sand supply of appropriate particle sizes from the designated source areas.
Still a need for the monitoring of turbidity and the effects on seagrass & benthnic creatures.
It may have less effect on erosion near the shore and therefore on use of the beach
As per answer 9
This option would supply the very large amount of sand needed to ease or solve the beach erosion problems where most severe (e.g. West Beach). The 'mass nourishment' strategy makes good sense to me. Although more costly than option 1.1, it seems a more substantial and longer-term solution to the erosion problems. As I remarked in replying to option 1.1, any dredging option shown to be environmentally viable (through Environmental Impact Statements) is superior to options requiring use of on-beach heavy machinery, or requiring construction of a land-based pipeline entailing the destruction of dunes and their ecosystems. Option 1.2 is also attractive financially compared with the destructive on-land options which destroy the 'mined' beaches, dunes and community amenity.
Ruining seabeds that are trying grow seaside seagrasses
Dredging
The only sustainable option
1. Provides a FLEXIBLE and ADAPTIVE management and whole-of-system approach to the management of Adelaide’s Beaches
2. The LOWEST CAPITAL COST option
3. EXCLUDES the need to construct, maintain and decommission an inflexible and costly pipeline from West Beach to Largs Bay and Semaphore and avoid carting.
4. MINIMIZES COMMUNITY IMPACTS on:
a) public safety (i.e., truck movements on beaches and in suburbs, excavations on beach and intertidal zone);
b) public amenity (i.e., noise, truck speed, beach closures and nuisance impacts);
c) the natural environment and coastal erosion (on the dune and beach environments and habitats and accelerated coastal erosion of the
dunes);
d)local infrastructure
ADDS BENEFITS to
d) the local economy (i.e., role of beach, dunes and foreshore in visitor economy and supporting local business activity)

e) the role of the coast in identity of place (i.e., activation of beach and community activities in dunes and foreshore)
F) Works with nature and not against nature by allowing sand to be naturally distributed
G) External sand is needed to maintain shoreline position, providing a sustainable solution to all beaches.
Possible at 2km offshore. Again, Environmental Impact Statement would be required.
Dredging will be the most flexible and the most efficient way to bring sand where it is needed today, starting at West Beach, and tomorrow, where number of other locations will need replenishment of sand as the intensity and frequency of storms increase.
Dredging is also the only way to bring sufficient sand to create a mass-nourishment (sand engine) and work with nature to slow down erosion as it has been done successfully in other part of Australia and other countries like the Netherlands.
It's important that an environmental assessment is conducted to identify and monitor the sand source and the dredging operation in order to limit the environmental impact on the seagrass and marine ecosystems.
Little detail, will inevitably cause sand build up at Largs, North Haven area as this is new sand. This could damage the sea bed.
Very costly ongoing short term solution
Again severe damage will be done without the public knowing.
The sand is not there, the marine life will suffer. I don't think you could collect enough sand to only do it once every few years
The mass nourishment strategy seems a good one.
Would supply the large amount of sand needed for severely eroded beaches such as West Beach.
Does not require heavy machinery on beaches.
I would support this option if extensive research is done into harm minimisation for marine life, including the impact of potential plumes
Environmental impact
Better than pipeline which will close beach etc
This method also damages the sea ecosystem, destroying seabed and creates silt in the water damaging the whole local ecology.
Unmonitored offshore environmental damage.
No permanent impact to beach amenity. Provides flexibility to collect sand from multiple areas as appropriate. Utilises natural wave motion to deposit sand onto beach. Added advantage of greater number of sand sources that could be utilised
Does not involve easy machinery on the beach and disruption to wildlife
expected to have lowest environmental impact

This is my most preferred option because it can deliver even better outcomes on most of the reasons cited for strongly supporting the first option above ie, flexibility and capacity to adapt to beach erosion in other areas, least harmful and best option for sustaining healthy beaches and biodiversity, economical. Same final comment as above, pre and post dredging and ongoing environmental impact monitoring and assessment is critical.
Possible at 2km offshore. Environmental Impact Statement required
Minimises visual intrusion and disturbance for our community associated with
permanent structures within the coastal environment
Provides opportunity for sand nourishment and equilibrium within the coastal
environment
Could ensure appropriate sand volumes to protect assets and maintain beach
widths
- One of the most cost effective options
- minimises the impact for all beach users as it does not make the beach inaccessible for periods of time every year
- would expect the sand would be dredged considering least impact to the environment and our total SA coastline
Keeps trucks OFF all beaches and allows all beaches to be accessible maximum time
- Minimum impact to residents living in the surrounding areas of where the pipeline pumping stations are planned
Achieves the objectives of the review
• minimal disruption for communities,
• avoids environmental harm, and
• maximise sand staying on beaches by sourcing coarser more suitable sand as an option
Dredging
1. Provides a FLEXIBLE and ADAPTIVE management and whole-of-system approach to the management of Adelaide's Beaches
2. The LOWEST CAPITAL COST option
3. Excludes the need to construct, maintain and decommission an inflexible and costly pipeline from West Beach to Largs Bay and Semaphore and avoid carting.
4. MINIMIZES COMMUNITY IMPACTS on:
a) public safety (i.e., truck movements on beaches, excavations on beach and intertidal zone);
b) public amenity (i.e., noise, truck speed, beach closures and nuisance impacts);
c) the natural environment and coastal erosion (on the dune and beach environments and habitats and accelerated coastal erosion of the

dunes);
d)local infrastructure
ADDS BENEFITS to
d) the local economy (i.e., role of beach, dunes and foreshore in visitor economy and supporting local business activity)
e) the role of the coast in identity of place (i.e., activation of beach and community activities in dunes and foreshore)
F) Works with nature and not against nature by allowing sand to be naturally distributed
G) External sand is needed to maintain shoreline position, providing a sustainable solution to all beaches.
This option is still a reasonable option with similar advantages as option 1.1, this is slightly more expensive than option 1.1 and does not stipulate how long the project would go for.
Minimises disruption to community and relative low cost
Would rather option 1 but wouldn't rule out other option
Potential environmental seabed damage, damaging plumes along with lack no clear sand source. EPA approval highly unlikely
less disruptive than other options, kinder to public (and i mean this genuinely). Less disruptive options allow local residents to continue to enjoy outdoor 'green space' and on the peninsula, the beach is the 'green space'. No trucks means safer for all members of the public: mothers and kids, older or disabled people who find need firm sand in order to be able to access the beach. And not least of all, less disruption to the dunes, which provide habitat and protect against further erosion of the coastline.
This technique requires no heavy machinery on beaches, meaning less disruption for communities and beach users. It provides flexibility and can adapt to changing erosion hot spots. It is the best option for maximizing sand staying on the beach. It is the least environmentally harmful and has the ability to restore the beach profile while increasing biodiversity. It is also one of the most economical, sustainable and protective options in the face of sea level rise and climate change impacts. To ameliorate any impacts of dredging a range of environmental management activities including turbidity monitoring pre-and post- dredging seagrass surveys will be undertaken. Environmental assessments will be conducted on source site and monitored by the EPA.
Being an offshore system will minimise disruption on the beach
Prefer pipeline with Coastal Reefs
Dredging effects unknown
Impact on bottom flora and fauna
This is not a long term solution. It can be easily defunded, leaving our beaches at risk
Another sensible option but again, would need a comprehensive Environmental Statement.

Not a permanent solution
We've already been through the assessment of sand at stanvac with the previous CRG and a determination was made there was insufficient source of accessible sand there. Outer harbour and Largs has no epa approval and unlikely to get it with disease and sand quality questionable around the port river channel. A genuine delay tactic in my mind.
Same as for 1.1,. In addition though sand engines have been proven to be effective in the Netherlands and a mini sand engine was recommended and modelled by DHI for West Beach in 2018.
Sourcing sand from offshore rather than near shore of the northern beaches is more expensive, but still much less than the pipeline options. Hope that effort is expended to find suitable sand sources
does not destroy local beach
If the off shore deposits have been identified why are there more investigations needed, have they been approved by EPA, more reports, investigations & no action
What defines 'offshore'?
There is not enough information in the discussion paper to support this. For example, how often would this be required and how much is 'large'. As the option says, it MUST be subject to further investigations and approvals, and without this, it is not possible to support it.
An additional concern that I have is that this and Option 1.1 are framed about dealing with West Beach. Another approach is to consider the future of the West Beach facility and the possibility of phasing it out, relocating it or closing it.
I don't support option 1.2
Because of the following reasons, and several stated in option 1.1
1. Unknown sources of sand, volume, quality and availability. Extensive previous searches have not located sand including Pt. Stanvac being deemed unsuitable in 2020.
2. Potential large time delay in sourcing, testing, gaining approvals, and most definitely fighting environmental concerns and activists. (warranted) .
3. Environmental concerns in destruction of sea grass beds, Sea floor and marine ecosystems.
4. Extensive time to complete works, time estimates vastly understated in report. Depending on location of sand source.
5. Definitely not future Government/ change of government safe.
6. Potential for lengthy delay only to be potentially deemed unsuitable, waste of time and money to possibly only return to the position we were in 3 years ago Carting vs Pipeline.
7. During time delays assumption is made that carting will continue. Has the been factored the cost of Dredging.
Because of information I have read from Save Our Shores (SOS)

Dredges already used at Outer harbour and elsewhere. Terrible to see what's happening at Glenelg with noise and beach fenced off for many months of the year. This seems to be a much better idea
This option indicates where the sand will be take from and hence, restricts it from being taken too close to the shore or where seagrass beds lie.
This would need extensive environmental impact assessments before going ahead
No identified sand source. Impact on marine floor. Further unnecessarily delays the installation of Option 2.1 which is the only feasible option.
Damage to marine life
Environmental impact statement required
No pipeline. No damage to the dunes. No heavy machinery harvesting sand. No trucking. Dredging offshore is less impacting.
Less disruption, more flexible and lower cost.
Less impact to beach and locals. Hopefully less impact to Seagrass
Practical, flexible, efficient and economical
The marine ecosystem of Largs Bay, Largs North, Taperoo and North Haven are our local breading ground for blue swimming crabs , squid, and other speices.. Our calm waters are perfect for garfish. We dont want our water friends disturbed. There needs to be a impact report.
Minimal disruption to beach users

Please explain your level of support for Option 1.3 - Combination of dredging offshore deposits and trucking quarry sand

as per previous comments
This option has on-going emissions production from a boat and truck powered by fossil fuel. A fix needs to be i place that has little or any on-going work or labour requirement. Also visual and noise impacts.
not sure using not aquatic sand is good - do we introduce things that may damage marine
This seems like a feasible option however it introduces trucks and a higher cost. I see no valid reason why this is a superior option 1.1 or 1.2.
It is however a superior option to all other trucking options
Waste of money.
on data presented :
- Not cost effective (Estimates are selection phase so little engineering completed to get to better than +/- 50%
- impact on local residences and traffic

- damage to roads (a cost)
- large environmental and social impact
Support what ever is required to maintain a usable beach.
Loss of sea grasses. Loss of various living forms eg crabs What time of year will it occur. Winter can be very rough on water.
Cost, practicality, traffic, beach usage disruption
Refer to previous responses
Trucks on the beach may impact beach users and would make the beach less attractive.
Dredging is a destructive process. We need to protect both the ocean and shorelines; they are part of a dynamic system and you can't damage one without damaging the other.
Need more information on environmental impacts
Best option. Safe and efficient, with no impact on beach users at collection areas.
Not sure about bringing quarry sand to the beach.
Complicated, requires lots of machinery which isn't good
Trucking activity on the shore is highly disruptive; the cumulative reduced amenity of dredging and carting is substantial. The additional benefit for cost vs. (1.2) is unclear.
trucking not good
Would rather see money spent on finger groynes to hold the sand where it is placed instead of drifting to the north.
Price
Introduces truck pollution, erodes land-based sand into the ocean. Other options keep ocean/dune sand in the ocean
The off shore sand and quarry sand needs to be deposited all along the coastline and I odontological believe this would be maintained
Trucks damage beaches and kill hooded plover
Seems expensive
We should avoid trucking except for stop gap measures.
Trucking is noisy and intrusive
Irresponsible, carbon intensive , ineffective, disruptive to beach goers, road traffic
Quarry sand to high in limestone. PLEASE read 30 years of past reports on this subject and ACTION the recommendations.
Have answered that on previous page
As above and not sustainable as quarry is a finite resource and truck movements are highly disturbing especially when required in large numbers to move these quantities

Sand should not be imported to the beach environment as a long term solution. It is not sustainable
Negative Environmental impact. Keep Heavy transport out of the suburbs.
Quarry deposits make water cloudy and silty and make for dirty swimming conditions. People want to use a beach for an enjoyable swimming experience
Too much traffic
Quarry sand does not belong on beaches. The environmental effects need to be considered ahead of people's desire to have sandy beaches.
Environmentally bad and embarrassing to South Australia
I don't like quarries
Doesn’t eliminate trucks
If you can dredge form the north back to the south might work
Cost of additional Quarry sand together with the environmental disturbance of vehicular beach traffic
inefficient
I walk along beaches Grange to Largs Bay all year round and the trucking is a huge inconvenience and degrades the beach surface and causes cliffs of sand that stops access and egress of the beach; shocking between Semaphore and Largs Bay jetties
Benefits already listed: maintains beach and dunes on northern beaches.
The addition or quarry sand means ongoing / faster top up to replenish west beach and henley. Seems like a win/win
See previous comments
Trucks on the beach at West Beach are only good for the sand carting company dollars.
Most inconvenient to beach goers and the Plovers that are supposed to be protected.
Environmental damage. Quarry sand is not beach sand
I think it would provide sand with the more disruption to the beach goers, but the damage it will cause to the sea bed and the surrounding marine life will be less
Dredging impacts marine organisms negatively through entrainment, habitat degradation, noise, remobilization of contaminants, sedimentation, and increases in suspended sediment concentrations.
The sand receiver community would be disturbed during the trucking campaign on annual basis.
And it’s not cost effective when we have free sand available within the adelaide beach system
Don’t dredge south of the area - makes no sense
It will work and over time you will most probably need this option to attain the volume of sand needed.
Why not just bring in quarry sand rather than potentially disrupt the ocean ecosystem.

as an interim measure this might be alright but it is expensive, so the sooner we develop our capacity around those strategies that are more sustainable, the better of the State will be financially. Individual beaches might be desperate for interim measure and you would not rule it out on the basis of expense because the do-nothing option may be more expensive. it is a much better option than taking it from other beaches because there are a lot of hidden costs associated with that approach.
The quarry sand is useless for us as it gets dumped in large piles along the dunes, makes that section of beach un usable and seems to do very little for the sand totals. Plus not keen on the trucks as they make a hell of a mess of the beach.
No evidence of sustainability / concern of available resources over decades to maintain this work
Quarry Sand is expensive and will cause huge consequences once exhausted for the Building Industry.
Slow, expensive, weather dependent and beach disruption.
There was not sufficient information in the discussion paper to make informed input. There was no assessment of environmental impact of options or carbon emissions impact. There was no long term system change options presented. There was no explaination of why other options were not assessed. The options represent status quo and are not suitable options.
Large trucks on the beach are dangerous. I do not support mining dunes for sand
the dredged sand needs to be placed near shore to form a sand bank. using truck does not acheive this. sand deposited by trucks is soon washed away.
The addition of trucks seems like an added burden on the environment. Why do both?
The seabed is also at risk and should not be destroyed.
Just using extractive industries to cover up bad engineering decisions
Slightly better than dredging
Do not supportNo minimum distance from the beach
Not support with current information, minimum distance offshore needs to be specified
Sand at Largs Bay beach is fine and will not stick at west beach. You cannot ruin Largs Bay beach.
Not favoured with current information, as no minimum distance offshore is specified
We need more info, sand quality needs to reflect that deposited at henley and port noarlunga. If It's sydney beach quality then that's fine. Rubble or shells through it I have issues. How does dredging ensure sand quality?
trucking in sand is a slow way of moving bulk material, as well as the nature of running diesel trucks constantly
Only if using quarry sand
Trucking sand is expensive and can be cancelled at any stage due to cost
1) cost
2) disruption

3) use of trucks
Pollution from trucks , noise . We are trying to mess with what the sea wants to do , you can keep on fighting against beach erosion and keep on carting . Again destroying the sea bed .
Creates jobs
I don't support having trucks on the beaches
Both finite resources. Quarry sand is needed to restore the profile in a closed loop system short term but if not recirculated from Outer Harbour to West Beach, it will eventually be lost to the Gulf.
This is very environmentally destructive, it would require a huge amount of diesel to be burnt to run machinery and trucks to deliver the product creating a very large amount of C02 emissions.
This is a good environmental option ONLY as long as NO sand carting is taken from any suburban beaches. And provided dredging remains at least 2km off shore
Good environmental option for all beaches
Don't support use of quarry sand
This is the best solution as we need extra sand on all beaches to reduce impacts of climate change.
No trucks if sand coming from quarry is dropped into small pipe from a car park.
Can the government buy its own quarry to reduce cost?
Its a bandaid solution and will cause significant disruption to beach goers,tourists etc
This sounds like a compromise to protecting sea life and maintaining beaches
As in the first question. Also stop cars on beaches on southern beaches that further impinges on the natural environment. The increase in vehicles on the beaches will have a long term effect on the coastline and wildlife. It is time to put the environment and wildlife before human endeavours. What sort of coastline will future generations inherit if they survive? Humans too are dependent and part of ecosystems.
Dredging too disruptive to environment - no risks provided in info
Introduction of external sand seems costly
Your site has a glitch I would support this to obtain coarse sand
If you use a combined approach how can you tell which one is being the most effective. Sand cutting has been used previously and shown to be ineffective
Quarry sand is a good option but you've lumped it in with dredging which is not an accident. The truth is, it's impossible to get you to see the folly of your actions when your income is predicated on a pre-conceived outcome to this process.
There is no mention in this option of how far offshore the dredge could collect the sand.
Supplementing with quarry sand is excellent though
this is ok as we you can have the mix of the beach and heavy quarry sand that is heavier and stays longer. YOu would have the impact of the trucks and this is a much more expensive option.

see above
Again, using the least damaging ecological factors should be used in approach.
Doesn't seem a sustainable option to use trucks for transportation of sand
Remove Adelaide shores groin
Trucking sand is expensive, unsustainable and disturbs beach users/ residents. However, quarry sand is usually clean & good appearance etc.
Short term solution only with disruption to beach users.
Do not want trucks on beach
Surely we can let nature do what nature does best
Do not support removal of sand from Largs, outer harbour or section banks. Concerned about bird life, marine life, sand grass and amenity of the areas.
What is quarry sand? Do you mean sand dunes? What is the environmental impact?
Disruptive and expensive
Concerns about safety of trucks around kids in beach. It's hard to handle already when the trucks have been there. Also when sand is piled onto the beach sometimes there are voids underneath that some people can fall into- already seen them myself - and it's pretty impossible to keep kids and dogs off the piles or hills
Disruption to beach where sand is collected from
Quary sand may have impurities
quarry sand is proven to be the right grain size etc but trucking environmentally and on the beach less preferred because of loss of beach amenity during operational times
say 4 months / year
Keep trucks off the roads
Damage to beach and foreshore
Damage to seabed and unsustainable.
This would only work with quarry sand. Too much disruption and unsustainable for Northern beaches.
Distance in carting quarry sand (which is not 'indigenous' to the area and will not be good for marine and coastal life and environment). Avoid use of trucks, plus it is washed away.
Dredging only No machines or taking existing sand from the beach.
Scenario A & B depict the reality of offshore sand deposits.
A, - 'hope a source' is found in the next 5 years additional investigation.
B, - we didn't find more sand and Stanvac is nominated (not a genuine source).

Incorrectly the annual nourishment has been lowered to only 90,000m3 from 115,000m3 per annum.
The volume of sand sourced off shore Largs Bay, location of sand, quality of sand untested. EPA approval unlikely, untested. EIS unlikely, untested. Total 'nonsense' lacks any genuine assurances on delivery, time waster resolved by total quarry sand delivery with those greater costs, therefore, again greatly improbable.
Placing deposited sand, west of surf break, unlikely to benefit West Beach and rebuild beach and dunes.
I'm just cautious of trucks on our beaches.
Impact of trucks on beaches
Loose access to beaches for 4 months and involves large noisey machinery
Trucking sand for next few decades- poor environmental impact and increased road congestion
We've got to stop digging up land areas. There are scars all over the landscape from quarries.
It's not an long term solution and I don't want to see sand carting trucks on the local roads.
Happy to see the sand come from Largs bay and Outer Harbour but what is the impact there and are resients happy for this to happen.
Trucking is not a long-term solution. It relies on trucks, which run on fossil fuels. Trucks also clog up the roads and beaches. It's also more expensive than Options 1 and 2 which seem a lot more logical.
Minimal impact on beach environment and allows unrestricted pedestrian access. However, does carting additional quarry sand exacerbate the sand flow north? i.e. does more sand being added to the environment mean more sand to flow north?
Same as previous answers including: how long will quarry sand deposits last?
Trucking from quarries will also be disruptive to those beaches in need - where sand is eroding because of previous man-made activity!
If using a dredge we might as well do it fully with a dredge
Would prefer to see less trucks on the beaches if at all possible. If there were a mechanism to use drift to achieve the same goals it would be better... although this may be a naive comment.
I don't see the need for sand carting if the needs can be met from offshore dredging. It seems an unnecessary hybrid option. Out of interest, I provided feedback around 2 years ago when there were two projects running - one to dredge sand from the harbour, and the sand carting at west beach, and suggested as both were looking at similar quantities (50,000T ish) that you might dredge and then pump this sand onto West Beach. No feedback was received. Not a great example of joined up government I would suggest - the two projects seemed ideally suited at face value to gain the benefit at limited cost.
Strongly opposed to trucking - poor use of resources, pollution from the trucks. But bettee than trucks on the beach!

Sand carting is invasive and often means bringing unless sand is quite dense it simply washes away. It is a waste practice to do that. Please consider dredging the Murray river sands to dump off shore to fix the beach sand issues.
Negative impact on the ecosystems and sea life
Destruction of the beach from diggers trucks and noisy polluting trucks
this is the best option from the options as you would take sand from man made quarries and return to natural lands. other options dumb as you can't destroy habitats, there's no profit and more harm then good
Not enough information. How far away would be quarry sand? What does that mean for the environment? How often and how much sand would have to come from quarries? Seems to be very environmentally unfriendly
Has been a wast of money to date and the sand size has been too small and it just disappears at the next high tides with rough conditions. Expensive and was implemented forpolitical reasons not a solution..
Not a deliverable outcome
I feel very strongly that the decision on how to treat our beaches must NOT be in the hands of just anyone. These decisions must be made by people with marine and environmental science expertise. We need to use the best system according to what the science says to help fix and protect our beaches.
Trucking sand gouges out the beach and makes it dangerous for beach goers.
Wish to avoid all options which involve trucking
Technically good idea but unlikely due to siltation.
The sand from land based quarries is a different type of sane to beach sand amnd is 30% more likely to remain in situ.
No trucks - and too expensive
Too much sand at Largs North
Want to leave the sea as natural as possible, only revert to this if absolutely necessary.
To truck from taparoo Beach to West Beach or Glenelg north maybe more cost effective than dredging
Please refer to previous comments regarding the dredging option.
What is the point of doing a half job of dredging that will cause disruption to local communities in the northern beaches, will cause environmental harm - Largs has not and likely will not recover from the mining that occurred recently and fine grain sand will be taken from Largs which has been proven time again does not stay on the beach it's deposited on.
Trucks are dangerous on the beach
No minimum distance specified

The issue seems to be finding suitable large quantities of sand. Port Stanvac may not be available or suitable, all sand and areas would have to have EPA approval. There seems to be an element of fingers crossed and hope that sand is found in the next 5 years? 2029? Where is this from? Once again we would be left without any certainty and the prospect of endless rounds of seeking EPA approval with no guarantee of success. Trucking quarry sand is an expensive and harmful tot he environment.
Polluting and will destroy roads. Very expensive and needless
I would like the selection of sand to be strongly based on the diameter needed for the higher energy beach needs at West beach to increase effectiveness and duration of remediation. If the right sand cannot be sourced offshore without significant detrimental impacts then quarry sand would be appropriate for use. Having said that it would be good to minimise the trucks on the roads and long term energy requirements given the fossil fuels and climate change issues
This option looks too close to the shore and potentially disturbing/destroying the shoreline. Unsightly and obstructing use of the beach.
It's a good idea
Not favoured as no minimum distance from shore is specified.
Plenty of sand at Semaphore, Largs Bay etc
As a member of the Adelaide Sailing Club at West Beach we put up with 100+ sand carting trucks EVERY DAY. The road access they require comes within 7-8 meters from our front door EVERY TRUCK - EVERY DAY.
This is clearly not sustainable, environmentally responsible and has an incredible negative impact on our club, our hospitality business, our members, our visitors EVERY DAY.
We have a risk management and traffic management plan in place to avoid the intersection of TRUCKS and CHILDREN using our sailing school during the day.....
ANY sand carting via truck on public roads should be avoided at all costs.
Trucks and equipment on Semaphore and Largs Beaches is 100+ meters away from residents. try 7-8 meters away EVERY TRUCK - EVERY DAY
Not favoured, as no minimum distance from shore is specified.
Short term solution only
Damaging and dangerous, unsightly having trucks on the beach
Dredging problems are the same as the previous 2 options and we are after a subtainablel method to use and quarry sand is too expensive to move, the environment does not endless truck movement from a source of sand miles away when there is already sand in natures own system just moving north and piling up on northern beaches.
Trucks on the beach make the beach unusable for long periods
not favoured, as no minimal distance from shore is specified.
Environmental concerns

Dredging problems are the same as the previous 2 options and we are after a subtainablel method to use
Sand quality not as good
As above and it will need more trucks on the roads destroying infrastructure
Waste of money. There is no such thing as a long term solution as the coast is a dynamic system which has operated for millions of years before human settlement and will continue after humans have left.
See answer to question 11 - further investigations will take time that we do not have & if they prove unviable then what ??
Not sustainable
Not supporting documentation
Cost effective. Doesn't seem as intrusive with machinery on the beach
dont want large trucks driving up and down the coast or on the beaches!--too noisy and disruptive to beach goers and local residents
The truck & quarry sand requirement is not ideal but provides flexibility.
There is no information about how far from the shore the dredging would be, nor anything about the environmental impact. Also, I oppose sand trucking as the trucks drive down my street (Bower rd) and as they're so heavy completely rattle my house every time they pass. Its a major concern for me as my house is an original 1910 cottage and I've noticed a lean since living here. Heavy sand trucks rattling my house would NOT help this.
DEW has told us for the last twenty years that the quantities of sand needed do not exist in St Vincent's Gulf. They are the government agency who have continued to research this fact. Any trucking is not sustainable or environmentally friendly in today's world
Still means trucks on the beaches
No Trucks on Semaphore/Largs Beach
No trucks on the beach - relies on truck carting being funded in future
No distance from the shore is specified and do not like continual trucks on the beach. Noise and air pollution. Also risk of children or animals being hit by the trucks as the driver is up so high and they are close to swimming areas.
This would be acceptable providing the trucks make minimal incursions to the beach. Trucks on the beach are noisy and dangerous and create pollution.
Questionable viability
Anything
Not good environmental practice to disrupt the sea bed, will destroy sea grasses. Also requires approval, so this is not a given resolution

Offshore deposits from Lefevre Peninsula area, its anchorage and channel access to Port River should be strictly avoided. Do not disrupt the tidal flows in these areas. Off shore sources should be local to the problem, otherwise you are just creating another problem somewhere else and appearing to favour one area over another.
Don't support dredging, due to disturbance of sea bed, sea grasses and local ecology.
Not sustainable
Dredging seems least invasive and this is the most thorough option allowing various locations.
How sustainable is the quarry sand sourcing and what is the cost benefit analysis between quarry source and dredge source only.
Trucking sand is a disruptive, environmentally unacceptable, suboptimal solution.
Nevertheless, trucking quarry sand is the least bad solution in the absence of seaborne sand delivery. If adequate seaborne capacity cannot be achieved on schedule then trucked quarry sand may be required as an interim top-up, but not as a long-term or permanent solution.
Adequate seaborne capacity must be established without delay.
Any trucking requires heavy machinery on shore which imposes a considerable risk to users, or the risk of shutting down beaches
How far from the beach would the sand be sourced? Also would need an Enviromental Impact study to ensure it causes no harm to the marine environment.
Don’t agree with trucks on beach
This technique has limited heavy machinery on beaches preserving beach amenity, provides total flexibility to where sand can be delivered, places the sand in the nearshore where it can be most effective in restoring beach profile equilibrium using natural forces and is sustainable with increasing sea level rise. It is also one of the most economic solutions.
Only if in combination with sand engine and the trucks aren’t driving up and down the beach, just dumping in location. Do not want trucks on beaches.
Only in the event that seabed deposits fail to meet requisite nourishment quotas.
Increased traffic pollution & noise for NOT just local residents at excavation sight(s) through to destination along with aesthetic hindrance & ongoing negative impact on natural environment.
Also no minimal distance stipulated for dredging. Only support if done at least 2km off shore AND after a favourable outcome from an official environmental impact statement
Probably the only solution
Not favoured as no minimum distance from shore is specified.
Refer previous comments
Trucking should be avoided as much as possible as it disrupts communities and is hazardous
Dredging sand is NOT an option due to destroying (smothering and choking) reef and seagrass habitat. Dirty water blocks sunlight and so kills seagrass. Thick silt cover kills healthy reef habitat.

We have already lost 80% of seagrass along metro Adelaide. Dredging would reverse the increase in reef and seagrass health
Seed for Snapper project - fishers
Waste water - Bolivar
Greenfeilds wetlands /recycles water
Shell reefs
Will need to look carefully at environmental impact assessment and more detail about using sand closer to Semaphore and Largs Bay, in particular Section Bank (which includes Bird Island). Section Bank has not been used before for strong environmental reasons and there will be significant community pushback on this site. Also reservations about using sandsources closer than 2 km to shore, and trucking on the beach. The first two options seem much more environmentally friendly and more acceptable to a community, who does not trust the Department for Environment and Water. This lack of trust has evolved over three to four years of working together over sandcarting, and their insistence on a pipeline.
I want trucks off beaches
This also seems like a fair option. similar concerns to 1.2 around environmental impact and similarly around where the land-based sand would be coming from and is the sand most effective is places offshore rather than on the shoreline?
All options do not give sufficient attention to the environmental and micro-organism/micro-crustacean impacts of moving sand or adding quarry sand - i.e. actual and potential environmental impacts.
Minimal intervention in terms of timeframe.
No information on the environmental impacts or considerations were included in the discussion paper.
Are there proven offshore deposits to dredge? Impact on sealife?
If dredging can achieve the required objective then introducing a complementary approach seems unnecessary and less cost effective.
Both good options
no minimum distance from the shore is specified
I believe dreading would adversely effect the marine environment
Not favourable as no minimum distance from shore is specified.
Support would depend on how far off shore the dredging will take place and how the quarry sand will be deposited. If this requires heavy machinery traffic on the beach I strongly oppose the option.
I much prefer dredging over the other options but prefer no trucks on the beach.
This would be conditional on the trucks not entering the beach zone and the sand was deposited in conjunction with the dredging arrangement.

The review does not consider the effect of dredging on the offshore environment.
Relocation of moving sand has least impact upon existing established sand deposits along the coast, and retuens sand to a place of origin and minimises disruption of sand beds that are more stable with their own envirenments and away from the coast
This appears to be a reasonable option so long as it utilises deposits where extraction will not significantly disrupt the status quo and introduce other environmental impacts.
I am not sure quarrying sand is sustainable in the long term
Driving large truck up and down beaches as a source of supply is not viable for residents of West Beach and Henley Beach. Adding more sand constantly means there is more sand going north and Semaphore residents will soon say they have to walk miles to get to the water
Truck on the beach are destroying the dunes and disrupting use as well as being unsightly and expensive
how could anyone think it was ok to resign west beach to quarry sand!
Dredging problems are the same as the previous 2 options and ongoing truck replenishment is both expensive and bad from an environmental viewpoint.
Trucking sand is a disruptive, environmentally unacceptable, suboptimal solution. Nevertheless, trucking quarry sand is the least bad solution in the absence of seaborne sand delivery. If adequate seaborne capacity cannot be achieved on schedule then trucked quarry sand may be required as an interim top-up, but not as a long-term or permanent solution. Adequate seaborne capacity must be established without delay.
I think the sand needs to be delivered to the beach, not (just) off the beach.
If the quarried sand is dumped onto the beach this has proved useless, as it immediately washes away.
I do not support this for the reason outlined in previous comment concerning dredging.
Trucks are a nuisance and hazard on our beaches, a floating pipeline will impact on how beaches are enjoyed by a large number of community members. The presence of trucks combined with floating pipelines will have a significant negative impact on how a large number of community members use our beaches (especially over the winter months).
Climate change is a fast approaching reality, and as storm surges increase, the St Vincent Gulf's sea level rises and erosion of all beaches along Adelaide's coast increases, it makes sense to bring in more quarry or other heavy weight sand into the system rather than mine existing sand in a vain attempt to prevent the inevitable. To cart or pipe the fine sand from any of the northern beaches will continue to erode the fragile dunes protecting those beaches. This is not only way more expensive than option 1.3, it flies in the face of strong evidence that dredging as along the Nederlands coast both reduces beach erosion and supports the establishment of dunes, which can at least slow the impact of rising sea levels.
Don't like using quarrie sand as it's not natural to the beach environment, there is enough beach sand it's just all in one area of coastline

In my view interfering with offshore sand will create another issue in those areas and then we have two problems--trucking quarry sand may help to some degree however there is the cost as well as the science to consider in this option.
Interfering with the environment will be a never ending waste of time, resources and money, which can be better directed by the Government into more productive areas such as Hospitals, Roads and Schools.
Damage that would be caused to the marine habitat
- The distance from the shore to the dredge has not been identified, the following advantages apply if this distance is 2km (as in the 1.1 and 1.2).
- No trucks on beaches
- Flexible and adaptable
- Barge can dredge sand from a number of appropriate sources and deliver to anywhere there is erosion along the metropolitan coastline
- Possible offshore sand sources need an Environmental Impact study
- Cost effective
- Cost less than Options 2 and 3
- No mining of beaches required
- Much less community disruption compared to pipeline and trucking
- Will build beaches rather than lower them
- No beach is degraded to advantage another
- No environmental harm to dunes compared to the pipeline
- Has been proven to work well in other places in maximising sand staying on beaches
- Less ongoing intervention and maintenance
Trucks are not a sustainable solution
Not good for beach use and environmentally
Don't understand why land sand needs to be trucked to a beach which has heaps of sand
Still involves dredging
Oppose sand cartng
Changes quality of the sand on the shore
Previous studies have already suggested that deposits at Pt Stanvac (wrong density causing turbidity) and Outer Harbor (risks spreading disease to oyster beds) are unsuitable. Cannot see environmental impact study for dredging off Largs passing combined with opposition from fishing industry. We also had a moratorium on trucking on the northern beaches because of perceived safety risks and yet we continue to persevere with trucking on the central beaches.
Do not support trucking - high cost, environmentally unfriendly, adds to traffic congestion

I don’t support use of quarry sand
This option is not economical and also doubles the environmental impact.
Dredging is a bad option - too much damage to the seabed and environment.
Most flexible of 3 options put forward. Least disruptive to beach amenity and communities, most effective in keeping sand on beaches, Most cost effective.
Trucking on beaches is counter to beaches environment, the flora and fauna and to human beach users. The disruption, damage and danger and holes and deep indentations left by trucks are a hazard to the beach populations.
Negative impact to beach users
Onshore disturbance with trucks should be avoided where possible
Environmental damage to seabed, seagrass, marine animals
The distance from the shore to the dredge has not been identified in this option. The following advantages apply if this distance is 2km or greater (as in the 1.1 and 1.2).
- Flexible and adaptable.
- Using quarry sand as a coplementary sand source lessens the impact of a massice offshore dredge from one source
- Cost less than Options 2 and 3
- No mining of beaches required
- Much less community disruption compared to pipeline and trucking
- Will build beaches rather than lower them
- No beach is degraded to advantage another
- No environmental harm to dunes compared to the pipeline
- Less ongoing intervention and maintenance (compared to a pipeline)
There needs to be a process involved to compact the sand once it arrives at West Beach. Otherwise, it will just be "swept" away continuously. This isn't a long term, ethical, sustainable solution. It would have irreversible impacts on the planet. Unless these are hydrogen powered / e vehicles, I am very against this option.. Military road and barcoo road are also not designed for heavy vehicle access, there are so many cyclists and runners in the area - creating a significant safety concern.
This allows even more flexibility with the use of quarry sand as a resort only when needed.
Safety of Sand from near the port river is a concern, also this seems like a wishy washy option. We don’t know where the sand will be dredged from and where the dredge will be sourced from. Seems likely we will end up only with quarry sand and the environmental impact of trucking quarry sand into west beach.
Do not support carting sand by trucks at all
Very intrusive

Trucking is destructive and too disruptive.
but only if the sand is suitable for marine life
less disruption, getting costly
Disruptions on the beach.
Too complex
But don't dredge sand from Port Stanvac again. Dredge offshore from Largs/ Semaphore where the sand from central beaches has accumulated.
Concerned about plovers and walking dogs in the morning, with heavey vehicles
Would erode the beaches here quicker
As above plus damage on beach itself with use of trucks also we will not be able to use the beach during these times.
Because dredging will directly affect the marine environment, the seabed and fish stocks and professional livelihood of fishermen and create another environmental issue that we will have to address in the future. "Robbing Peter to give to Paul".
It disrupts other beaches and creates more problems
This is not considered a viable sand collection method as commented on for the Options 1.1 and 1.2. There are no known offshore sand deposits within an economic distance from Adelaide beaches.
The use of sand from sources located outside the Adelaide coast to add to sand reserves to counter loss of beach width from climate change is necessary, as advised in the Adelaide Living Beaches Strategy 2005 - 2025, Technical Report. Importantly, the sand grain size needs consideration to obtain the best value of sand stability on the beach. The coarser the sand, the more it resists being moved by waves and currents.
Since this has ongoing top-ups of sand I would have thought it more likely to maintain a good sand level than just one large dump. However, there is more disruption for beach users with the annual carting, so not ideal.
minimum distance from shore of 2km is required
Dredging not proven option in local or similar area.
Environmental concerns
Disruption and damage to sea grass and marine life + quarrying sand too expensive to be sustainable.
Not favoured, as no minimum distance from shore is specified.
This is a good option PROVIDED it stays OFFSHORE
Carting quarry sand is an excellent environmental option.
Off shore dredging is possible at >2km offshore only - but an environmental impact statement is required.

Appears to be able to provide a large amount of sand to replenishbeaches
Disturbs seabed
Concern that dredging will damage sea bed, cause greater turbidity in the water.
do not support, because no minimum distance from shore is specified
i am against dredging
I believe there are alternative solutions
No mention of distance offshore for dredge. Do not support in close dredging.
No minimum distance from shore is specified
Not sure if this would impact sea creatures living on the sea bed
Damage to the sea bed and ecosystem
sand is already being lost from the coast line.,it we
still does not solve problems
Truck on the beach will cause degradation to the wildlife and sanctuaries, will cause pollution, noise and public safety concerns.
This will also significantly limit the usability of our beaches while the trucks are operating.
Trucks on the beach, regardless of way of entry/exit will not only be unsafe but also disrupts the environment. On one hand, we protect the birds in the dunes, but on the other hand, we allow heavy machinery noises and vibrations - this is hypocrisy. Moreover, some people may come to the beach to relax, unwind, improve their mental health - again, heavy machineries will cause disruptions to that.
Depends on effect on sealife
Don’t know enough
Is it appropriate to introduce quarry sand into the marine environment?
See above
Negative impact on the marine environment.
If a beach is so degraded that external quarry sand is required then that is a temporary option til the dredging has a chance to work
Have no objection to using quarry sand as back up, but the same problems exist with the dredging of feasibility of process, sand quality, and effect on seabed, and the knock on implication of timescales with no short term solution for Henley Beach South.
Not favoured as no minimum distance from shore is specified
dredging may damage the sea floor, sea grasses where native fish species breed
As per previous response

This would still mean machinery on our beaches. Dangerous to beach users, not cost effective and damaging to shore and beach environment generally.
Truck pollution
impact of community too great but the biggest is that fact that Largs Bay is losing sand naturally anyway. Proven fact when using 'nearmap' software.
I did a school project on this exact issue and all the information I found said that the short term gratification (cheaper cost) of any dredging based proposal would not be worth the long-term environmental impacts and with all-likelihoods being we would eventually need to build the pipeline eventually anyway.
Impact on environment and disruption to the community
While scuba diving I personally witnessed damage caused by turbidity, sedimentation and reef smothering at Port Noarlunga reef due to previous dredging that occurred at Port Stanvac. I am completely opposed to dredging in SA waters because of the environmental damage it causes to coastal, estuarine and marine ecosystems, including reefs, seagrass and benthic marine life. In addition, water quality is likely to be affected and could lead to environmental nuisance where swimming occurs. It will also potentially have an economic impact on tourism and local small business, especially diving companies.
Sand trucking is totally disruptive to beach users
Not the right solution
Taking quarry sand to West Beach is the least environmentally and community damaging for Le Fevre Peninsula and positive for West Beach.
Environmental damage with dredging and availability of suitable quarry sand
Support but need to know the distance of dredging from the shoreline
Only the beach being replenished would be affected
would be an option if required and cost effective, not as good for the environmental impact
This will need to be done to create enough buffer
This option does not state how far offshore the sand will be collected.
Ideally reduce or eliminate trucking but I can imagine that a combination might be required in certain areas to make sure placement is accurate.
Dredging problems are the same as the previous 2 options and we are after a subtainablel method to use and quarry sand is too expensive to move, the environment does not endless truck movement from a source of sand miles away when there is already sand in natures own system just moving north and piling up on northern beaches.
Dredging would have a high impact on the coast. Unlikely that this proposal would receive EPA approval.
It is not known whether there is a suitable sand deposit available.

Dredging sand near the shoreline would impact water quality.
Quarry sand is not the same under foot
This involves dredging the "Section Banks and surrounds" . Dredging here is likely to cause environmental damage to migratory shorebird feeding areas. The odds of approval are reduced by three investigatory reports resulting in the curtailing it as an option previously
Too expensive
Not proven. Too many risks and unknowns. Is there adequate sustainable sand reserves. Will EPA allow it? Trucks on beach are dangerous and diminish amenity of beach for beach users
Do not like the idea of using trucks to manage sand cartage as it seems as an inefficient and environmentally unsound way to manage this task
Do not support trucking as it makes a huge mess of the beach and not environmentally friendly.
Trucking quarried sand is a nonsense, its expensive and should only be considered as a last resort. We who live in these beach environs know that the sand migrates to the north and "stockpiles" when it reaches the river outfall. this stockpile of excellent quality sand simply has to be continually harvested and distributed wisely as required. This would maintain the channel outfall to the sea and ensure the natural stockpiling to be available to be managed, far more cheaply than importing quarried sand.
Not sure of truck involvement
This technique has limited heavy machinery on beaches than the pipeline or carting options preserving the beach amenity and providing somewhat less disruption to communities. It places sand in the near shore allowing nature to build up the beach profile while maximizing sand staying on the beach. It is also an economical solution. To ameliorate any impacts of dredging a range of environmental management activities including turbidity monitoring pre-and post- dredging seagrass surveys will be undertaken. Environmental assessments will be conducted on source site and monitored by the EPA.
To get the sand pumping unit off the beach
Need a minimum offshore distance specified. Why is Largs Bay being picked on.
Can't be micro managed easily ... and would work out dearer in the long term .. with regard to deliverability, environmental carnage, a political / community dividerer and no sand as source without inevitable environmental marine decimation.
Using trucks on the road is not an environmentally sound option
Any option that involves trucking and machinery on the beach is very short sighted. Noisy, disruptive, unsightly, polluting. A negative in terms of tourism and the environment.
Trucking quarry sand is the worst idea as it is releasing an extreme amount of green house gasses. The dredging offshore will not help the problem either.
Quarry sand does not support marine organisms and trucks on beach damage habitats

This sounds like one of the better options since it will be minimal environmental impact on Semaphore and Largs beaches. Sand trucking from land based quarries is OK.
Same as last answer
Trucking is environmentally unsustainable
keep trucks off the beach
I am worried about disturbance of the sea floor, and possible loss of sea grass. I also worry about disturbing and distributing toxic sludge from Outer Harbor. Again, I question the futility and ongoing expense of trying to intervene in a natural, dynamic system of Northerly sand drift. Houses at West Beach, Tennyson, Brighton and Somerton should never have been built on the sand dunes.
no trucks on the beaches, sand is not correct type of sand
The sand would have to be somewhere around the area it's missing do not go to some morels to disturb the sand there and cause the same trouble
Cost and trucking making suburban roads unsafe and noisy.
There is sufficient evidence that the sand that is currently being trucked from Largs and semaphore is not actually solving your issue at westbeach, the sand is too fine - and its causing issues for our own beaches that climate change impacts are going to mean we need our sand to say where it is.
Avoiding trucks on the beach should be a high priority but trucking quarry sand is better than taking it by trucks from Semaphore or Largs Bay
Potential hazards of large trucks around beach users
The trucking solution is simple and easily managed.
best solution
There is no specification of how far offshore the dredging would take place. If it is set at at least 2km's then this option would be OK for reasons outlined before.
No trucks on roads
Trucking causes too many problems and safety issues for residents - harms the beach and makes it unusable.
I do not support use of unsuitable sand from the deposits mentioned, but I would support replenishment from an external offshore source if a suitable one can be found. However this seems either unlikely or prohibitively expensive. If such a project were to proceed, it would have to be on a very large scale (to justify bringing in a large ocean-going dredge) and it would be unlikely that such a large project would be combined with smaller scale use of onshore quarry sand. Use of quarry sand might need to be considered as a last resort, but keeping the beaches would need to be balanced against the negatives associated with large scale trucking.
Fresh sand is required to maintain the size of the sand. as the particle size is reduced by recycling the sand the drift increases.
See previous

Quarry sand comes with it's own environmental impacts. Sand from the land should not be used in beaches. I believe it's better to dredge washed away sand from the gulf, but again the environmental impacts are important.
Do not support mining of metro beach
The deeper you go to collect sand the greater chance of damage to weed beds
Not favoured, as no minimum distance from shore is specified.
Environmental vandalism. Not a long term practical solution.
Not supported as no minimum distance from shore specified for dredging
To disruptive to the locals affected by the work scope
Better solution to sand pumping and more cost effective.
Trucking is the least desirable.
I dont think enough work has been done by the department to understand the environmental impacts of trucking sand along out beaches. Some of these dunes areas are very fragile. The churning of the shoreline through heavy machinery has an impact on the dunes and the nesting hooded plovers in some of the areas this is occuring e.g. Semaphore Park.
In line with the previous two options it is unlikely the amount of sand required would be sufficient to save the beaches currently depleted of sand. There is no guarantee that appropriate sand suitable would be located. Unlikely of any EPA approval and are a hopeful stop gap solution and does not solve the ongoing problems
Same answer as previously mentioned
Again, what will the impact be to the seabed. Trucking is also time & cost consuming. It blocks areas of the beach to the public.
This option would only require trucks on the receiving beach so would not impact our area so much.
Trucking is absolutely not on, the worst , apart from pipeline, option of all
Due to the environment concerns to due turbid and the effect on the sea grass, the storage of the dredge, lack of sand source, over Carbon footprint of running the dredge & Trucks for 20 years. Trucks damage the road and beach infrastructure.
It depends where the sand is taken from ie how far offshore, but if 2km offshore then this might be a suitable option.
Options 1.1, 1.2 and 1.3 look to be the least environmentally, socially and economically damaging overall of the options provided.
This option is much more expensive than the previous ones. We have observed over a period of time, the futility of trucking sand, the extreme disruption to beach usage and the sheer danger of trucks occupying and transiting the beach.
Lower impact on beach environment -flora fauna environmental disruption and people's enjoyment and access.

My overall preference is NOT to Dredge OR use a Pipeline - both are reactive solutions to the problem. My overall preference is to address the root cause of the issue (Climate change, Increasing Storms and Wave Movement) and create an artificial reef or breakwater ~1km offshore. Addressing the cause, not the symptoms is my strong preference.
Nevertheless, I have selected 'Support' as this technique has limited heavy machinery on beaches than the pipeline or carting options preserving the beach amenity and providing somewhat less disruption to communities. It places sand in the near shore allowing nature to build up the beach profile while maximizing sand staying on the beach. It is also an economical solution. To ameliorate any impacts of dredging a range of environmental management activities including turbidity monitoring pre-and post- dredging seagrass surveys will be undertaken. Environmental assessments will be conducted on source site and monitored by the EPA
This is probably the most realistic as there needs to be a big nourishment event at the beginning while the dredging replaces sand gradually. I also like the flexibility of the trucks and dredges to deliver sand to the location where it is most needed.
Dredging is supported and Trucking is not, so i have downrated to "Support" because i presume dredging will be dominant. I have researched studied many options for sand management of beaches and have concluded that dredging whether near shore or offshore is the best option in terms of minimal environmental impact, value for money, least negative impact on community and safety whilst delivering the desired sand management outcomes.
Double estimated cost if dredging only plus environmental and social impact of carting quarry sand on roads
This technique has limited heavy machinery on beaches than the pipeline or carting options which would mostly preserve the beach amenity and providing somewhat less disruption to communities. It places sand in the near shore allowing nature to build up the beach profile while maximizing sand staying on the beach. Supplementary sand provided from quarries would be more protective of Adelaide's northern area beaches, ensuring that their dunes and the infrastructure they protect are not put at risk of erosion by lowering of beaches in the face of sea level rise and higher frequency of storms. Delivering sand via dredge would be less disruptive to communities and would not see major roadworks or infrastructure works impacting residents, travellers and businesses.
It is also an economical solution. If a cost/benefit analysis was done of the all the options, the dredge options would be the most cost effective with the least damage to existing infrastructure, least disruption to businesses, communities and tourism and the most likely to maximise sand remaining on beaches. To ameliorate any impacts of dredging a range of environmental management activities including turbidity monitoring pre-and post- dredging seagrass surveys will be undertaken. Environmental assessments will be conducted on source site and monitored by the EPA. This technique would also not disrupt the historical and cultural landscape of the Kaurna people, the traditional custodians of the Adelaide plains.
This solution as proposed currently does not ensure the long term permanent nourishment of the southern beaches and the potential risks and uncertainty associated with long term sand availability and opportunities for nourishment are considered significant. Support for this option would only be

provided with caveats - specifically that the potential risks below are first addressed and that additional initial nourishment would take place to ensure the equilibrium within the management cell
Potential benefits
Minimises visual intrusion and disturbance for our community associated with permanent structures within the coastal environment
Provides opportunity for sand nourishment and equilibrium within the coastal environment
Would ensure appropriate sand volumes to protect assets and maintain beach widths
Minimises intrusion for the community within the northern beaches associated with sand trucking and heavy vehicles
Local beach users and residents would experience disturbance associated with heavy vehicles in the road network and on beaches
Potential risks
Uncertainty around environmental damage associated with dredging (ecological, seagrass degradation, water quality)
Uncertainty of additional licenses and EPA approvals required and the long term security of these
Uncertainty of sand source location
No actual recent data has been collected to confirm if off shore locations or quantities of required sand are appropriate
Residents and visitors to southern beaches would experience unreasonable impacts associated with trucking and heavy vehicles on beaches
The proposed initial nourishment of 250,000m3 quarry sand over 2 years is inadequate to address the immediate needs of sand on beaches and will exceed littoral drift
The nourishment volumes have also been based on the 90,000m3 per annum loss rate which is undervalued by 25,000m3 per annum or 10,000m3 per 4 year cycle
Trucks on the beach not preferable. But please do something the beaches are disappearing
Land based sand supplies are, by definition, limited. Is this the best use of a finite resource. Is undoing the cause a better option.
no minimum distance from shore specified
No specified distance offshore? would support if it was 2km off coast and did not result in trucks on the beach.
This seems to offer less intrusion on the beach than other options.
Flexible and will be able to target erosion hot spots
Less environmental harm
Less disruptive for communities, beach goers and beach ecosystems
would prefer a solution that didn't involve bringing in quarry sand and trucks

No trucks. there is already enough sand on the northern beaches, why access the quarries its completely ridiculous
How far offshore?
as above comment 1.1. long term not sustainable. Dredging off shore has significant effect on the marine ecology and the tidal flows.
Refer to comments re option 1.1.
Also, this option does not allow for a mass fill at the start which I believe is required for West Beach.
Prefer that trucks aren't on the beach.
Impact on marine life
See answer to question 12
This technique has limited heavy machinery on beaches than the pipeline or carting options preserving the beach amenity and providing somewhat less disruption to communities. It places sand in the near shore allowing nature to build up the beach profile while maximizing sand staying on the beach. It is also an economical solution. To ameliorate any impacts of dredging a range of environmental management activities including turbidity monitoring pre-and post- dredging seagrass surveys will be undertaken. Environmental assessments will be conducted on source site and monitored by the EPA.
Hate the trucks
Depending upon the proportions of dredged vs carted, this may reduce the impact upon the sea bed. I would more strongly support if the larger proportion was carted from onshore quarries.
There has been an acknowledged lack of meaningful data that supports a viable sand source for any dredging options. No scientific modelling has been done therefore there is uncertainly for the environmental impacts of dredging as well as the timing of implementation which would have further devastating affects on the central beaches already eroded and depleted of sand (West Beach, Henley South, Henley Beach). There is no certainty that the EPA would grant a licence to dredge so questionable that any dredging options proposed were even practical. Concerned that dredging and its impacts are "out of sight/out of mind" for the average person and hard to ensure that environmental damage is indeed not occurring.
In addition, DEW's 2020 report concluded that Port Stanvac is not considered a viable source of sand as sediments are not suitable or adequate to replenish West Beach. Other sand sources sited (i.e. Section Bank) has POMS which means it is not viable for use in the immediate future. Other potentil sand sources (i.e. Largs Bay) have lack of data and has yet to be properly assessed and analysed. This uncertainly means that 1) it might not even be practical or 2) may add years to the implementation - time that the central beaches do not have.
I like the combination of dredging and quarrying, but no mention is made of a minimal distance for dredging offshore. Is this trying to sneak in a close to shore dredging option?
Sometimes supplementary sand is necessary

Beach sand needs to be managed. I am happy for the experts to determine the best way.
I've fewer concerns about trucking quarry sand but remain concerned about any dredging of the ocean floor.
Dredging is detrimental for marine life.
Same as both above
Anything is better than nothing. I dont see how this could work.
I am opposed to any trucking of sand from onshore beaches. We can see the destruction at Semaphore beaches due to this practice and environmental advice is that an increase in big storms will further increase erosion.
No minimum distance from the shore has been specified.
Duck the trucks it's a public place of beauty not an open cut mine
Good option with minimal impact to fragile dune and associated eco systems
The land sand must be of suitable size or it will not be effective
I think this is an ok option as it will cause less harm than taking sand from other beaches, does not need a pipeline, and will have less impacts environmentally for the coastline and socially for residents and tourists.
Illogical to have 2 methods.
Costs will rise dramatically.
Quarry sand could be chosen for particular grades that wouldn't wash away so easily.
As previous. Not addressing the issues
May be less destructive to bottom ecology
Past investigations in 90s n 2000s have shown offshore resourse is no longer viable due to size n quantity particularly after dredge program around Port Stanvac n Noarlunga Reef in 1997.
We must avoid trucks on our beach as much as possible
Quarry sand is no longer a natural sea sand contaminating the sea environment.
Although effective and efficient, I am concerned about dredging up existing habitats and depositing silty sand mid water close to the beach
The previous options are simply much better.
while has some benefits of strongly supported options 1.1 and 1.2, it does have negative impact of some machinery on the beaches.
Quarry sand is a great option
The availability is there .
No damage to beach
Off shore so no trucks carting on the beach creating further damage

No disruption to beach goers
Keep trucks off the beach at all costs. If you had to use trucked in sand, it must be as a last resort. As I wrote earlier, and trucks on the beach create an unusable beach.
Ok with dredging, but reluctant to support trucking quarry sand without knowing details
This option keeps sand collection offshore, avoiding damage to beaches through collection by sand planes and trucks. It deposits sand in the nearshore where I believe it will be most effective in retaining sand for longer in areas where it is needed. It also provides good flexibility to be able to move the barge along the coast and deposit sand in areas of need as circumstances change. this is particularly important as we experience the effects of climate change on storm activity and sea level rise. The importation of quarry sand is not a long term solution, and I see it as a short term strategy to top up if necessary.
• Desk Top review only
• Lack of identifiable sand sources.
• No time frames for identifying a sand source and subsequent modelling and analysis.
• Whilst this may be viable in other parts of the world, no modelling or analysis specific to the Adelaide coastline and Gulf St Vincent has been conducted.
• If a sand source is identified the necessary studies, analysis, modelling and approvals could add years to any implementations.
• We have been consistently advised that Pt Stanvac is unsuitable – in 2020 a DEW report stated The DEW report stated that:
"Based on the analysis of potential dredging risks and the properties of the sand that could be delivered to west beach the department has concluded the at the Pt Stanvac sediments are not suitable or adequate for replenishment at West Beach".
• Section Bank has POMS making it unusable in the immediate future.
• Deposits in Largs Bay have yet to be determined and analysed.
• There is uncertainty regarding the impacts of dredging.
• Concerned that any environmental damage becomes “out of sight, out of mind” – Just because we can’t see the damage, doesn’t mean it doesn’t exist.
• This option also requires trucking sand from quarries, which is expensive and means that West Beach would have both trucks on the beach and be subject to the unknown consequences of dredging.
• This is the least equitable solution for West Beach.
• Sand would still end up on the northern beaches.
No minimum distance from shore specified
Less damage to beach and foreshore than pipeline or planing/carting options
No minimum distance from offshore is specified

In addition to the above justification for dredging over any form of pipeline/sand carting, using large deposits farther from shore would be the preferred dredging option. Dredging already is occurring there, and sand from Port Stanvac has already been used as source sand.
1. Dredging/quarry sand does not ruin the beach, does not put trucks on the beach. Dredging/quarry sand can be used when other beaches require the sand; it does not require permanent, invasive infrastructure on the beaches. Dredging/quarry sand is far less expensive than other options and has far fewer negative impacts on beach users and nearby residents.
2. Semaphore/Largs/Taperoo beaches are used not only by nearby residents, but also by northern suburbs via the Expressway. these beaches are very family friendly, but will not be so with trucks and noisy infrastructure on them.
3. If this review supposedly considers the future of all Adelaide beaches, why have you not considered where the sand will come from when you take too much from Semaphore/Largs/Taperoo beaches?
No benefit above 1.2
Increased road trafic
Dredging near offshore deposits too environmentally impactful
To expensive
Sounds much better than a pipeline or trucks, subject to environmental impact assessment results.
Can not read all of the information, or select a support option, on this one but it would be the better of the options, utilising quarry sand
Sand trucking makes Beach visits unsafe for my family and unpleasant in general
Flexible, less disruptive to beach amenity and communities but still has trucks on the beach.
This has already been tried and has raised much dissatisfaction.
The trucks are so dangerous, loud and intrusive.
This is one of the options to include using both quarry sand and dredged sand. I have no knowledge of the pro's and con's of either type of sand, nor the impact of the acquisition of either sand. But I hope someone with that knowledge will guide the review to its conclusion.
As all the beaches are eroding, and sea levels are believed to be rising, land based quarrying would appear to be the best option
It has all the values of the dredge options particularly 1.2.
Quarry sand provides a supplement for sand nourishment with possible larger particle size to give a better mix to the replenished sand.
However the method to get the quarry sand to the beach need attention.
All the dredging options are consistent with the dutch experience over the last 30 years
They will get trucks off of our beaches,
They will work with nature to maximise sand staying on beaches

They will cause less environmental harm
They will be less disruptive for communities, beach goers and beach ecosystems.
They provide the best financial option being a third of the cost of a pipeline.
External and different quarieed sand will create bigger holes / quaries and disturbance of land with truck use
As per number 9 though this involves trucks on beach so not as supportive as 1.1 and 1.2.
This option 1.3, like option 1.2, would provide 'mass nourishment' at maximum-erosion sites such as West Beach. It would be less potentially taxing on the offshore seabed ecology at Semaphore-Largs-North Haven than 1.2. Option 1.3 is a more 'elastic' strategy in that utilising quarry sources of sand as well as offshore sources of sand allows adjustment of the relative amounts coming from the two sources depending on ecological factors and other contingencies. Also, any dredging option shown to be environmentally viable (through Environmental Impact Statements) is superior to destructive options using on-beach heavy machinery, or a land-based pipeline wrecking dune ecosystems, both of which also have a calamitous effect on community amenity.
Use of quarry sand in addition to dredging may help reduce environmental impact of dredging
Dredging
The only sustainable option
1. Provides a FLEXIBLE and ADAPTIVE management and whole-of-system approach to the management of Adelaide's Beaches
2. The LOWEST CAPITAL COST option
3. EXCLUDES the need to construct, maintain and decommission an inflexible and costly pipeline from West Beach to Largs Bay and Semaphore and avoid carting.
4. MINIMIZES COMMUNITY IMPACTS on:
a) public safety (i.e., truck movements on beaches and in suburbs, excavations on beach and intertidal zone);
b) public amenity (i.e., noise, truck speed, beach closures and nuisance impacts);
c) the natural environment and coastal erosion (on the dune and beach environments and habitats and accelerated coastal erosion of the
dunes);
d)local infrastructure
ADDS BENEFITS to
d) the local economy (i.e., role of beach, dunes and foreshore in visitor economy and supporting local business activity)
e) the role of the coast in identity of place (i.e., activation of beach and community activities in dunes and foreshore)
F) Works with nature and not against nature by allowing sand to be naturally distributed

G) External sand is needed to maintain shoreline position, providing a sustainable solution to all beaches.
Possible if over 2km offshore and external quarry sand used. EIS would be required for confirmation
Carting should be only a short term solution if there is not enough suitable sand for dredging, or as a fill gap before the barge and required equipment are available
Environmental assessment should be conducted for the source of sand
Little detail, will inevitably cause sand build up at Largs, North Haven area as this is new sand. This could damage the sea bed.
Costly short term solution
Dredging comments above. Our marine life deserves better
Would provide mass nourishment at maximum erosion sites.
Less damaging on offshore seabed ecology at Semaphore, Largs & North Haven than 1.2
Dredging superior to destructive heavy machinery on beaches and superior to a land-based pipeline ruining our dune ecosystems.
A much better outcome for all beach users on all beaches.
As with previous research into impact on marine life would need to take place and be publicised to the public
Environmental impact
It’s good but what distance will sand be dumped off shore
I do not support dredging at all. It's far too damaging to the seabed and will cause greater environmental damage
Continual offshore and coastal mining.. will and has previosly caused already further damage to respective beaches at semaphore and largs Bay.
I support this option less than 1.1 or 1.2 because there will still be trucks on the beach.
Do not support any option the has heavy machinery on my beach
no minimum distance off-shore stipulated
This is my 3rd preferred option because it has some / limited heavy vehicle use on beaches. It is by far better than current beach carting option and pipeline on all points raised above, and least economical option of 1.1, 1.2 and 1.3 options. Same environmental monitoring and assessment point applies to this option as previously stated for 1.1 and 1.2.
No minimum distance from shore specified
these options could work, however based on current investigations remain hypothetical. To be supported, a source of sand must be technically confirmed within the next 6 months. As well as recognising the regulatory hurdles these options must address (EPA Dredging License, Environmental Impact Statement etc) and so these remain tenuous solutions.

There is no minimum distance from offshore specified as to where the dredging is to occur
Dredging
1. Provides a FLEXIBLE and ADAPTIVE management and whole-of-system approach to the management of Adelaide's Beaches
2. The LOWEST CAPITAL COST option
3. Excludes the need to construct, maintain and decommission an inflexible and costly pipeline from West Beach to Largs Bay and Semaphore and avoid carting.
4. MINIMIZES COMMUNITY IMPACTS on:
a) public safety (i.e., truck movements on beaches, excavations on beach and intertidal zone);
b) public amenity (i.e., noise, truck speed, beach closures and nuisance impacts);
c) the natural environment and coastal erosion (on the dune and beach environments and habitats and accelerated coastal erosion of the
dunes);
d)local infrastructure
ADDS BENEFITS to
d) the local economy (i.e., role of beach, dunes and foreshore in visitor economy and supporting local business activity)
e) the role of the coast in identity of place (i.e., activation of beach and community activities in dunes and foreshore)
F) Works with nature and not against nature by allowing sand to be naturally distributed
G) External sand is needed to maintain shoreline position, providing a sustainable solution to all beaches.
There is no minimum distance from offshore specified for the dredging to occur and the cost is higher than option 1.1 and 1.2
Not as good as 1.1 or 1.2 as we will have trucks on beaches and it's a higher cost
Not in favour of trucks on the beach but will be necessary in the short term to restore Henley Beach
I do not support any trucks on any beach. Tòo costly.
No sand quantifiably identified.
No sand testing, core sampling all speculative 'hear-say'.
No EPA assurance and unlikely. Turbidity Plume etc.
No Environmental Impact Study assurance and unlikely. Sea Grass damage, marine life damage etc.
Sand delivery offshore to maximize immediate loss into Littoral Drift.
Pt Stanvac not viable, Section Bank infected or closed due to Pacific Oyster Mortality Syndrome, Largs Bay either near shore or 2 km offshore environmentally unfeasible.

Dredging is categorized as a total ‘Nonsense
Avoid trucks on beaches to minimise disruption to public.
This technique has limited heavy machinery on beaches than the pipeline or carting options preserving the beach amenity and providing somewhat less disruption to communities. It places sand in the near shore allowing nature to build up the beach profile while maximizing sand staying on the beach. It is also an economical solution. To ameliorate any impacts of dredging a range of environmental management activities including turbidity monitoring pre-and post- dredging seagrass surveys will be undertaken. Environmental assessments will be conducted on source site and monitored by the EPA.
Being an offshore system will minimise disruption on the beach. Carting sand while looking for the right sand source.
Prefer pipeline with Coastal Reefs
Impact on flora and fauna
This is not a long term solution. It can be easily defunded, leaving our beaches at risk
No minimum distance from shore specified.
Not a permanent solution
Wishful thinking
Dredging options the same as previously stated, approvals unlikely to be given so an exercise in time wasting and futility.
Quarry sand requires processing before it’s suitable and is susceptible to price gouging/ increases. Sand is besides fresh water arguably the most precious resource in the world for civilised societies and with an already known accessible source available on the northern beaches seems ridiculous to mine and fill the north beach with more.
Same as for 1.1. Extra note-Hope that effort is expended to find suitable sand sources, so that sand carting is minimized. However it's important to find the suitable and sufficient sources of offshore sand.
no minimum distance from shore is specified
Do not support
The same concerns about dredging offshore exists as above options 1.1 and 1.2. Trucking sand obviously has an impact on the amenity of beach users, however trucking quarry sand is a better option to moving beach sand from one spot to another
As per option 1.2 don’t not support for multiple reasons, stated above.
Additionally disruption continued at West Beach, trucks on roads and beach.
Sand will continue to drift North and build up, unused resource.
Because of information I have read from Save Our Shores (SOS). However, environmental assessments would still need to be made for this option.

Yes, this is also a less invasive option, however, without a distance restriction it could allow sand close to shore to be taken, damaging fragile ecosystems.
Using quarry sand only is the preferred option
Dredging only with extensive environmental impact assessment and should also consider rehabilitation of dredged areas
No minimum distance from shore has been provided
Heavy vehicles should not be permitted on ecological sensitive areas like beaches
As above.
Once again, i do not agree with you interfering with our natural habitat a long the foresores. You need to find another way. To much destruction in this form.. Leave the beaches alone. You are causing environmental damage.

Please explain your level of support for Option 2.1 - Pipeline using tractors/trucks on beaches

Has worked reasonably well at Glenelg to seacliff and has limited impacts on residents
There is less damage occuring
This option has on-going emissions production from a boat and truck powered by fossil fuel. A fix needs to be i place that has little or any on-going work or labour requirement. Also visual and noise impacts.
using sand that is already there
In light of the additional costs and the substantial environmental and infrastructure damage during installation any sand pumping option makes no sense. Unlike the dredging options this also introduces considerable beach user inconvenience and ongoing noise and interuption to ongoing residents. Further, if the old technology proposed last time is utilised its questionable that filtering sand before pumping is going to suitably bind to the beach.
Makes best sense in terms of visual pollution and environmental outcomes
Waste money. Let Nature work.
on data presented :
- High cost (Estimates are selection phase so little engineering completed to get to better than +/- 50%
- impact on local residences and beach users
- potential for repeated blocked pipes. Was this considered in operating costs?
- large environmental and social impact
Support what ever is required to maintain a usable beach.

Cost, practicality, traffic, beach usage disruption
Will ultimately be the lowest cost in the long term. The costing would take into account the large initial capital expenditure spread over 5 years. The true comparison should spread this over a 20 year design life.
This is also the most environmentally conscious manner to solve the issue
A pipeline and trucks would make the beach less attractive/relaxing. They may also impact access to the beach.
This is destructive to beaches and it is unduly intrusive. It interferes with people using the beach and it disturbs flora and fauna.
A pipeline would be a disaster.
Still has significant impact on beach users at collection areas
Too much infrastructure. Would take too long to establish.
Mush Less machinery with a efficient pipeline to transports sand permanently in place
Highly disruptive solution - permanent infrastructure and regular carting. Beach closures required.
terrible for beach users
We are never going to be able to fund placing enough sand to re-create the beach slope that used to exist before our ongoing sea level rise began, and stopping CO2 emissions is our only affordable hope.
Price and don't think we need to build the pipeline infrastructure
Support the pipeline but not the quarry sand
The pipeline will produce the required results and is permanent infrastructure that will be used when required
Expensive
Expensive and will see further destruction of Semaphore beach and dunes
Support pipeline but think we need to avoid trucking except as a stop gap measure.
Complicated, expensive, subject to failure, intrusive to coastline.
Irresponsible, carbon intensive , ineffective
Multiple past reports have recommended this system. It is returning the sand that has drifter north. Pipeline reduces truck traffic. This questionnaire should summarise the recommendations of all the past studies that have been ignored by government over 30 years.
Proven solution, from Brighton to Glenelg, more expensive initially but sustainable and minimal disturbance (after construction) supernatant slurry discharge above high tide mark so minimal impacts on sea grass beds
Pipeline with intertidal sand collection is a long term solution. Understand that quarry sand import may be required in the short term

Permanent solution. Lower running costs with lower impact on residents.
No trucks, pipeline only
It would be too disruptive to Beach users
Quarry sand does not belong on beaches. The environmental effects need to be considered ahead of people's desire to have sandy beaches.
Environmentally awful and extremely disruptive.
Too much fuss
Doesn't eliminate trucks that destroy the beach and removes the sand dunes that protect the coast. Not to mention the unpleasant environment the trucks create when the public are trying to enjoy our beautiful beaches seeking respite from the stress of every day life.
IT works well between Glenelg & Kingston Park so why not between Semaphore & West Beach
This exceedingly costly method is unbearably disturbing for a large period of time for a large number of residents and beach users.
inefficient , disruptiv
As above, I walk along the beach all year round!
Worst idea. Loud, disruptive machinery destroying our beach at Largs forever. Unusable for much of the year, Will devalue houses, will destroy our environment.
Seems to work well from Glenelg to Seacliff
Trucks on the beach at West Beach are only good for the sand carting company dollars.
Most inconvenient to beach goers and the Plovers that are supposed to be protected
Least damage to ecosystems
Environmental damage. Quarry sand is not beach sand
I think it would provide sand with the more disruption to the beach goers, but the damage it will cause to the sea bed and the surrounding marine life will be minimal
Sounds better than dredging, as long as these pump stations and pipelines aren't eyesores. If this is about saving money, find something else.
It's been tested before at Glenelg at it's working
This option should have been explained more clearly. The total operation time is 3-4 months per year but most likely the duration of time at each sand collection area would be around 1 month a year. So community need to understand the difference
It in some ways is comprehensive.
Durban's beach in South Africa has long operated a successful back passing pipe system.
Gold Coast City Council had long considered installing a similar sand backpassing pipe system especially along the Spit, Main Beach and Surfers Paradise Beaches.

Effectively a mine is being created on some of Adelaides most pristine beaches. Semaphore and largs is a tourist destination that in the past few years became a scene of heavy industry, preventing, for a large part of the year, safe recreational use of the beach. Large trucks do not belong in the place where thousands of residents live. Making dangerous and effectively preventing safe places to walk, jog, exercise, play with their kids, walk their dog, relax, de stress. Unlike suburbs to the east, the Port Enfield residents do not have large parks, or the hills close by. This is where they go. The biggest health threat for low social economic areas is obesity. Making recreational areas unsafe to use is ludicrous. After the last mining episode we saw dunes collapse, vegetation fall into the ocean and the summer water became a soup of seaweed due to the artificial topography created by the mining. Unlike in all previous years where the seaweed disappears for summer, it effectively collected in the depression made by the removal of sand. Sea lice exploded. Crabs were diminished and the sand whiting were non existent. It is criminal that sand mining on any suburban beach is even being considered as an option. Is it even legal to mine so close to residential areas? Destroying one beach to save another is never the answer.
Noise and safety, damage to environment
It would be a waste of money and a waste of our beautiful beaches. Our beaches should be enjoyed not endured for industry profit.
The pipeline is the only logical decision I feel, I do not agree with the quarry sand as a long term fix but would be happy to see it used to replenish our depleted beach.
West beach has suffered long enough supplying other beaches with their sand. A pump is a great fix.
No evidence of sustainability / concern of available resources over decades to maintain this work
The Dredging sand after being located on beach could be trucked to different locations
There was not sufficient information in the discussion paper to make informed input. There was no assessment of environmental impact of options or carbon emissions impact. There was no long term system change options presented. There was no explaination of why other options were not assessed. The options represent status quo and are not suitable options.
Trucks on the beach are dangerous. I don't support mining dunes for sand.. This option also sounds very expensive
The hybrid answer is dredge and pipeline.
I think this would be terrible for tourism in the area as trucks are large, noisy and intrusive.
It is clear there is on shore drift of sand. It is building up at the northerly beaches. The water has become shallow around the northern jetties. Pump it back to where it came from.
Fix the problem.
Waste of money
Continuous disruption to beach users
Damages the beach

We have seen the impact of trucks on our beaches. You only need to look at Semaphore beach and around Largs jetty when trucks and sand were removed by truck. The sand dunes and beach are still trying to recover.
You will wreak the source beaches to try and 'fix' another beach. Hugely disruptive to the source beach. There's still damage to the beaches of Largs North and Bay from earlier work.
Not sure, this sounds suspect to have pipes strewn over beaches.
Truck is the least effective option - small amounts and many trips...
This system has been used between Glenelg and Seacliff for 17 years and has worked well
1) cost
2) disruption
3) use of trucks
Same as above .
I support a pipeline but do not support excess heavy machinery on our beaches and driving through our suburbs.
A little better, as pumping the drift sand back to where it came from is not damaging the sea bed and pumps can be electric, run off green energy instead of diesel powered dredges.
This would be devastating environmentally for northern beaches, and comes at a huge financial burden to the state
Significant Environmental concern for local northern beaches
This option has not worked anywhere else. It causes the most harm to beaches and disturbances to beach goers and nearby residents
Don't think pipeline is a good idea
Sensible, sustainable solution
Sand being removed from beaches will degrade that beach. SAND IS NOT BUILDING UP ON NORTHERN BEACHES.
Trucks compress a beach and increase storm impact. Trucks interupt beach use and ambience.
Pipeline will degrade all beaches that are dug up to place it, it will be hugely expensive, it may not work efficiently, it has a limited life.
It will probably be uneconomic as huge quantities of sand will seriously arode foredunes within a year or two and public protest will become extreem.
Not environmentally friendly, proven it doesn't work already and waste of tax payers money. OH&S risk for the local community with trucks on the beach as well.
We need a permanent solution and not just a temporary fix.

Disruption caused to beach users over an extended period of time basically making the beach unusable in winter while sand is being taken and huge amount of damage it would cause (and has caused in the past) to Semaphore Largs beaches.
This is a better option..not disturbing sea life
Trucks? You have got to be kidding? Pollution, noise, disturbing the ground, where does this insanity come from. I expected environmental vandalism from a Liberal government, but not from Labor.
Ineffective and further degraded sand dunes
Because it has worked well better than dredging
Most positive solution for long term. Can always supply from dredge if onshore harvest to impactful
Still got your selection glitch! Would never support using northern sand, cosmetic waste of time and money
This option will destroy our delicate coastal ecosystem
Look at the destruction of Semaphore and Largs beaches caused by your previous efforts. The truth is, you've mis-managed the beaches for 50 years and this is more of the same.
An environmental, unsustainable and expensive disaster on so many levels
Destroying 13.2 kms of dunes and beach to bury a plastic pipeline in which an abrasive sand slurry will be carried to West Beach, dumping hundreds of thousands of micro plastics onto the beach and subsequently into the ocean.
No mention of climate change regarding lowering of the beach by sand planes and destroying intertidal flora and fauna adding to increasing sea level rise.
Disruption to community, visitors, businesses, tourists, car parks, roads and general mental health of all involved for 4 months of the year.
Beaches are no place for massive trucks and in Table 15 of the additional information provided it states the pipeline could NOT be used for the purpose of supplying the restorative volume of sand at West Beach indicating additional costs .
A big NO. The impact this would have on all part of the beaches including the environment, dunes, marine life and the flora and fauna.
The cost to do this is very expensive when you have much better options.
see above
A more permanent approach to the issue and future of the project. Logistics can't be avoided, but maybe using electric trucks or hydrogen vehicles would be a good approach to limit pollution to sand.
System seems to work well at Seacliff currently - why not continue it further up the coast?
Remove Adelaide shores groin
The most expensive and disruptive option, but still not sutainable.
Short term solution only with disruption to beach users.

Do not want trucks on beach
Hate the visual aspect of doing this. Looks dreadful seeing trucks as at present at Semaphore.
I have seen the impact of this activity. It ruins the beaches for users and damages habitat for shorebirds. too much sand is removed leaving the beaches hard and without good soft sand cover. The toe of the dunes looked degraded after the last sand extraction.
Same as above
Best of the option. Would like to minimise trucks and piles of dry sand dumped on west beach though for safety reasons
Same as previouse
This method seems invasive and expensive
apart from an open ended length of stay of equipment on the beach for pumping the pipeline construction will disrupt the fragile dune system and potentially create an ecological disaster with increased frequency and strength of storm events and sea level rise predicted.This is an acknowledged risk of climate change .
Placing sand ON the beach may work but will erode with longshore drift at a faster rate than nearshore littoral placement,
Finally what are the rates of wear particulate plastics added to the environment??Has this been determined with the southern pipeline?
Zero is a goal from a biological viewpoint since the damage to ecological systems is still evolving
At least it's a permanent solution.
Micro plastics released into environment and damage to beach
Minimal environmental damage.
It has already done incredible damage to the dune system from Taperoo to Semaphore, is based on outdated methodology and does not factor in climate change.
No pipeline or trucks
As above. No machine on beach or taking existing sand as the beach is being ruined
Huge impact on beach users
Piping is proven successful from Glenelg to Kingston park.
First option where Sand as a source is identified, qualified and assured.
Provides both mass fill 110,000m3 from quarry, and piped sand 100,000m3 each year from 2025, to reinstate West Beach. say 215,000m3 per year. 2025 to 2029. Reinstates West Beach as necessary!
Environmental assessment completed.
Delivery assurances year 2025 is highly desirable.

Sand ultimately placed at West Beach in the dry zone and not tidal area, or -2m AHD, ensuring community benefit prior to entering into littoral drift.
Disruption by trucks negated at West Beach, for the first time in 50 years or so.
This is just crazy, why destroy the dunes, have heavy machinery on our beaches to mine sand and place into a pipe to pumped down the coast. The costings are out of this world expensive. This method has not worked for the last 3 decades why persist...
Pumping option is good but disturbance for trucks and tractors on beach is not ideal.
Loose access to beaches for 4 months and involves large noisey machinery
Too much infrastructure. Not regenerative. Trucks on beaches never a good look. Plus we're then complementing this with the other options already discussed.
Will this work and will it solve the issue. have they looked at using sand bag gromes to hold sand in place. seem like a great idea to pump sand but will it work.
Just look at the mess that is Glenelg beach in winter and that's why pipeline is not a good idea. Also, as a local resident, the permanent pumping stations are just an eyesore. Also the disruption in constructing the pipeline would be horrendous. The cost is also extraordinary.
Disruptive to the beach environment and restricts pedestrian access. The sand carting over the last few years is very disruptive and destroys the beach scape.
I have been part of caring for the vegetation along the Largs to Taperoo dunes for some years, removing weeds and planting threatened species and so haver had plenty of time and familiarity to both witness the effects of the beach-sand-mining and consider the other suggested options.
Firstly: the process of digging for and burying a pipeline through our relatively narrow dunes will destroy the vegetation of up to potentially a half of the width of some sections of our dunes from wherever the pipeline begins to West Beach - where presumably it will end?
The suggested process of burying a pipeline - presumably must use large equipment with huge tyres and a need for wide manoeuvrability. This process has to be destructive to all sorts of vegetation and their general biodiversity, both by removing plants plus killing them due to damage.
Of course the promise of appropriate re-vegetation has long been promised but:
a. how long will this slow-growing vegetation take to grow back and
b. what happens to the unprotected dunes in the many years of 'growing back?
We are already seeing winter storms erode the beach edges of the dunes and if oceans are indeed rising this will no doubt get worse.
In general, I suspect that the process of baring up to 16 kilometres of our already fragile dunes will be potentially disastrous and, cannot possibly be predicted.
Secondly and again: I have witnessed and been effected by sand collected from our Largs and Semaphore beaches: beaches scraped bare to ugly puddles of salty water, trucks driving at dangerously high speeds and, in general our beach areas - commonly visited by many from the Adelaide northern suburbs, and as far north as Elizabeth etc - made into industrial and extremely

unappealing sites; a great advertisement for those wishing to enjoy our Adelaide beaches - summer or winter, the latter season I enjoy most!
ANYTHING BUT BEACHES SCRAPED BARE FOR A USELESS, BANDAID SOLUTION - PLUS 16 KM OF DUNE VEGETATION MANY METRES WIDE DESTROYED!
Thirdly: The pipeline, and any sand collection from our northern beaches is, as already mentioned, surely nothing but a bandaid solution as mentioned - the sand from our northern beaches reportedly too fine to stay in place for long and so drifting out to sea or returning north to be collected and piped south all over again and again and again?
As well as years of observation, these replies are informed by reports of many similar attempts to correct human-instigated damage to our beaches - from other areas in Australia and overseas.
So expensive and disruptive to build a pipeline.
Let the Sand build up and perhaps lo g term it would develop more extensive Sandhills
This is higher cost and higher impact than dredging. Although it appears feasible, I don't really see why you would choose this over dredging. Engineered structures have less long term flexibility, and require more maintenance and ongoing support. I suspect the environmental / carbon impact of the trucks is significant. The trucks themselves limit usability of the beach, impact safety, and create problems with access for people due to the size of the tyre track depths - many older people / disabled people struggle to walk over these.
Strongly opposed to ANY trucks on the beaches!!
The sand pipeline is invasive to the current environment, as is sand carting. It also involves moving sand that is proven to be less dense which will wash away. Sand carting is not preferred due to the invasiveness of the deliver to the beaches.
There is no mention of what would be the environmental impact to set up this pipeline...
Very noisy for residents a few meters away from the noisy machinery that runs all day for 6 months of the year
so much contruction so fucking stupid.
Pipeline seems to be a good option, but how much additional sand is needed?!
Destroys pristine environment and many case studies globally including Glenelg that it doesn't work and is so much more expensive. I think the Department was so far in it could not have a objective view first time around. Pleased that we now have sensible options.
Proven to work at Brighton to seacliff
Same as above
Extremely expense as a long term solution. Question: What have we learned from the cost of dredging the Murray Mouth and who is winning? Nature or Man?
Wish to avoid all options which involve trucking due to public disruption and noise pollution
Viable solution in short and mid term.

This would be catastrophic, the sand dunes at Semaphore South beach have already been decimated by the sand carting. The beaches have already eroded 70 metres since 1996, if the pipeline is implemented coupled with global warming we will not have any beaches left. Also it is an extremely expensive option and the sand does not stay in situ at West Beach anyway.
Too expensive and intrusive
Too much sand at Largs North
Less Traffic on the road, keeps the natural sand going through a loop process.
Restrict use of Henley and grange beaches
This is the most disruptive and expensive option. Sand mining from the beach (which is required to feed the pipeline) has already done damage to the dunes and beach ecosystems at Glenelg, Semaphore, Largs and Largs North. A plastic pipeline will add to the already serious problem of microplastics pollution.
This option does not meet any of the three requirements of the solution. It causes horrendous disruption for Semaphore/Largs communities and all of the many thousands of Adelaidians that use these beaches. Clearly the trucks are not removed from the beaches and roads and heavy machinery present on two of the states most popular beaches would be astoundingly backward. There is massive amounts of erosion along these beaches and the latest DEA data proves these beaches are shrinking and cannot be used as a sand mine for West Beach. The sand mined is fine and does not stay on the beaches and it is massively expensive. It amazes me that the pipeline solution is still even discussed it's that much of a discredited solution.
Trucks are dangerous on the beach
This is a proven method, that has been thoroughly researched, has been engineered, had planning and EPA approval. It is operating in the southern beaches and on the east coast. Our beaches need restoration and we need certainty in terms of timelines and delivery. It can be flexible and sand can be delivered where it is needed. Although the building of the pipeline maybe uncomfortable the long term benefits outlay this. As most of the collecting of sand will take place during the winter, it is unlikely to cause a lot of disruption to locals in the northern beaches.
Illogical and expensive
Absolutely do not support. This is ridiculously expensive and the negative impacts on communities and the coastal foreshore environments are too great. And personally, I do not want a pumping station permanently ruining my environment and my amenity to improve amenity elsewhere temporarily.
To build the pipeline would entail a huge loss of the fragile dune system to accommodate the pipeline for the sand and water needed for this proposal. It requires trucks to be on the beach each year to gather sand and other heavy, noisy machinery to be in situ for many months of the year. It is the most expensive options, it has a limited life and needs regular maintenance.
Same as above
Very disruptive to beach users and damaging to the environment.

The pipeline is there. The Sand at Semaphore, Largs etc is basically our sand that's shifted north.
While I'm against sand carting using trucks etc. it's simple: a sand harvesting and pumping pipeline works perfectly well between Glenelg Beach and Seacliff Beach. WHY cant it work, WHY wouldn't it work from Largs Bay and Semaphore Beach to West Beach?
ANSWER: It will work.
More of a long term solution fix. Please ensure south section of Glenelg North does not miss out on this!
The only reasonable solution given the science
We already have a model for this which works so well which they have reduced the amount of fills per year (unless due to storm activity). This is the Glenelg and Seacliff pipeline which along with our middle beaches are the most commonly used beaches of SA. Truck movement is done mainly off seasons with no problems or complaints from locals due to the gentle nature of getting the sand onto the beach in places where needed the whole dune and beach system has thrived. Rare boards (plovers) are stimulated not threatened by placement of a sand slurry and not trucks dumping. This also would need to be backed up with a mass fill so we can maintain the 1970 sand profile with the pipeline system.
The beach is churned up and dangerous for public use
Environmental concerns
We already have a model for this which works so well which they have reduced the amount of fills per year (unless due to storm activity). This is the Glenelg and Seacliff pipeline which along with our middle beaches are the most commonly used beaches of SA.
Best option with trucks only on the beach for small amount of time and not driving for many kilometres up an down the coastline to disperse sand and spread with excavators
disrupts visitation to the beach
Probably one of the worst and stupidest ideas, expensive, ineffective, disruptive and pointless. See response 13 above.
Most viable option - no further investigation & therefore no further time required...
No other environmental impacts to seagrasses or sealife
$$
Proven to work as shown on southern beaches Glenelg to Kingston
Trucks and machinery on the beach disturb the micro ecology of the beach - whats under the sand. It disturbs the local wild life - plovers, seals, crabs etc. it is noisy and dangerous to beach users. It churns up the beach. Local residents have to continuously bear heavy machinery on their streets. Noisy and disruptive.
dont want trucks on the beach disrupting beach goers and local residentse
lack of sand supply on eroding beaches, disturbance to dunes, beaches, beachgoers, beach ecosystems. Noise pollution and exorbitant costs are also significant factors.

I oppose tractor sand trucks on the beaches and I oppose sand trucking as the trucks drive down my street (Bower rd) and as they're so heavy completely rattle my house every time they pass.
Disruption to the dunes in creating the pipeline, infrastructure that takes up coastal space and is noise polluting.
And more expensive.
Stupid
No trucks on the beach
No distance from the shore is specified and do not like continual trucks on the beach. Noise and air pollution. Also risk of children or animals being hit by the trucks as the driver is up so high and they are close to swimming areas.
The pipeline is completely unacceptable - it is a ridiculous proposal! It would mean noise, machinery, disruption, and is an oldfashioned solution!
Proven solution on southern sa beaches. Most logical option to achieve desired results for ongoing health of entire coastline
Seems costly
Anything
This process has been shown to be more environmentally friendly and had need approved by precious government bodies
Definitely do not support this option, as it would be environmentally destructive in the construction process and still be taking sand from one area to resolve a problem in another area. The solution should be localised to the beaches suffering the erosion.
Least visually impactful. Proven technology, minimal unknowns, risk. Minimal disturbance of sea beds and sea grasses.
Too invasive and will get more expensive every year
I do not support heavy equipment on our beaches for 2 months of the year and permanent infrastructure such as pumping stations - 3 of which would be located along the most popular beaches, Semaphore and Largs Bay. The location of these stations and use of heavy equipment would impact these beaches turning them from regenerated dune systems to mechanised semi industrial sites like what has happened at Glenelg. This would be a very poor outcome for a significant number of residents and beach visitors in order to buffer one beach impacted by poor planning and neglect at West Beach.
1. It is an extremely expensive solution.
It entails a very big bet by SA taxpayers on a large, fixed capital investment that will need to be substantially written-off in the event of failure.
2. It won't work: sand on northern beaches is too fine-grained to withstand routine weather events and will be eroded again in the short-term.
3. The northern beaches will be damaged beyond repair by sand harvesting operations.

4. Properties and residents of the Lefevre Peninsula will be exposed to major risk from climate-change induced weather events (sand loss and dune damage has already been significant over recent years: 'the new normal ').
5. Beachgoers' amenity at the donor beaches will be unacceptably compromised by sand harvesting (as I know and can attest from experience).
Extremely heavy environmental impact, user impact, cost impact, and only benefits one beach to the detriment of many others
This method has been used in the past and was terrible for our local beaches at Semaphore. Trucks should not be on beaches. There has been much erosion of the dunes at Semaphore where sand was taken from. It at terrible idea.
Don't agree with trucks & large machinery on beach
Maximum disruption to beach amenity and communities. Beach closures, heavy machinery on beaches causing serious environmental damage, unsustainable with increasing sea levels, unsuitable grainsize and composition for a pipeline feed with the high carbonate content breaking down during transport into silt and quickly washing away. Pipeline produces significant volume of micro plastics, delivers sand only onto the beach which is only a cosmetic effect and very temporary failing all international metrics for renourishment durability. Very expensive.
No trucks in beaches. Noisy dangerous unsightly. Pipeline very disruptive to dune ecosystem.
Sand harvesting operations and increased storm events have placed the northern beaches under increasingly relentless attack, substantially degrading a once healthy dune system and putting the whole peninsula at risk of rising sea levels.
Those of us who walk on the beach every day have witnessed these changes first hand.
Right now, the dunes are at a tipping point. We have one chance to save them. So it's a big fat NO to pipelines and trucks!
Semaphore Park through to Largs nth have been dealing with this short sighted stupidity seeing negative impacts up til now. Can't believe this 20th century solution is still on the table for 2024 & beyond. Seriously!!!!
not logical
Most of the time they get in the way of the environment
No pipe line wanted
System works and is easy to maintain and service
The pipeline was part of the original plan for sand management and has been partially and successfully implemented in the southern beaches. The original project should be continued to build on its success and restore our central and northern beach. To date the job has only been 'half done'.
If we are moving sand for our own enjoyment of beaches and protection of our homes and infrastructure then we need to accept disruption to our lives - not expect marine life to suffer as a result of our needs and wants.

External sources of sand, quarries - where are they located? Where are future sand quarries located?
Our Community was actively involved in opposing the pipeline proposal from West Beach to Semaphore South, and submitted applications to SCAP. We were furious at the then Environment Minister's late changes to the guidelines (including and then not including Grange) with the burden of sand being drawn from Semaphore South and then later Largs Bay (dependent on another application to SCAP). We were unhappy with the lack of real information about the pipeline project that was presented at the information sessions just before the Planning submissions were due, and the quality of the Environment Department's application. At no stage were we provided with the full costs of the pipeline, so am pleased to see a proper costing, which far exceeds that of DEW's estimation. These costs are too high for a project that was estimated to have a life of 20 years. The pipeline was based on 20th
century data, and does not allow for climate change and the increase of significant storms within shortened periods. There were many impassioned objections from Semaphore and Largs Bay communities and this option is not acceptable to the community.
I want trucks off beaches
Disruptive to the beach/ shoreline and sand dunes and cost a lot more.
All options do not give sufficient attention to the environmental and micro-organism/micro-crustacean impacts of moving sand or adding quarry sand - i.e. actual and potential environmental impacts.
Expense and emissions.
Prefer not to have pipeline but and building up north of Largs jetty could be reduced
This option doesn't appear to require heavy machinery on West Beach so would not have the risks to beach visitors that other options present. It's unclear why this option would be better than dredging.
Traffic a hazard to pedestrians using the beach
Disruption to beach going public
This will not impact on the marine environment
What are the environmental impacts and never keen on trucks being on the beach
Clear evidence that removal of sand on shore severely impacts on rate of erosion of beaches and dunes. Negative effect on the coastal environment. Seriously impacts on user access and comfort and community mental health. Deleterious to state tourism, associated business and state economy.
Do not want to see tractors & trucks on the beach. Very disruptive & potential safety issues.
Coastline habit negative impact and visual impact
There would be a massive impact on and degradation of the beaches from which the sand is sourced.

There would be a huge negative impact on visitors and residents of the beaches from where the sand is extracted. The abrasion of sand inside a plastic pipeline would eject nano plastics into the marine environment. All the beaches between the collection point and deposition point would be excavated for said pipeline which is an abhorrent notion. The compaction of our beaches by heavy vehicles will also be disastrous for the beach ecology inc disruption to bird life, macro invertebrates, disturb the natural hydrology of the beach and contribute to increased frequency of localised higher tides. The sand in situ at proposed collection points is a natural line of coastal protection to assets owned and utilised by visitors and residents. We cannot afford to reduce our beaches in view of climate change and the increased frequency in king tides and storm activity. Beaches MUST be protected.
The pipeline from Glenelg to Kingston Park shows that this option is viable and sustainable (within the limits that coastal development has created).
Something needs to be done, but I dont think having trucks drive every summer is the answer.
More expensive but provides a permanent insitu sand delivery sytem and reduces heavy vehicle movemnet on roads
This option is using the best long term sand resource, which is the northern beaches (Semaphore Largs etc) and utilises beach collection and pumping as the primary collection and delivery method which has the lowest impact (pumping) and a reasonable recurrent cost
Pipeline that was well engineered would be good and more sustainable over the long term
The pipeline is a great idea. It seems like a similar idea that was implemented and then cancelled by the current government.
Destruction of the environment, expensive, disrupts usage of beach, unsightly one of the worst options
preference for a permanent solution is a no brainer
The Glenelg and Seacliff pipeline uses this model, it is proven and works well, is cost effective and supported by the local community. It also minimises any disturbance to nesting plovers and other birdlife.
Most reliable and trusted iption
1. It is an extremely expensive solution. It entails a very big bet by SA taxpayers on a large, fixed capital investment that will need to be substantially written-off in the event of failure. 2. It won't work: sand on northern beaches is too fine-grained to withstand routine weather events and will be eroded again in the short-term. 3. The northern beaches will be damaged beyond repair by sand harvesting operations. 4. Properties and residents of the Lefevre Peninsula will be exposed to major risk from climate-change induced weather events (sand loss and dune damage has already been significant over recent years: 'the new normal '). 5. Beachgoers' amenity at the donor beaches will be unacceptably compromised by sand harvesting (as I know and can attest from experience).

Returning the sand from West Beach to West Beach seems like the only way to maintain equilibrium. I know that long-shore drift is a thing, however, as a community we have built on the sandhills (at WB and generally) and if those sandhills erode, a lot of the city will be underwater.
this would potentially be the least invasive to surrounding wildlife, and permanent structures may as well be used as this is going to occur for a long long time
Disruption, noise, pumps, intrusion and cost.
The current pipeline has had 10 years of successful operation. Previously when carting was undertaken by trucks, tractors and scrapers there was continual concern about public safety and impacts on roads and houses along routes used by the sand trucks. There were constant complaints to the Minister.
The reliance on trucks/tractors to collect sand on-shore is a hazard, nuisance and undesired. It will impact negatively on those beaches and communities where the sand is collected.
See comments above
I think this is the best option and a more permanent solution but significantly more expensive
Looking at all of the above options trucking is required with all of them however the pipeline will minimise this and makes sense to me as it already works well with the pipeline from Glenelg to Somerton
Interfering with the environment will be a never ending waste of time, resources and money, which can be better directed by the Government into more productive areas such as Hospitals, Roads and Schools.
Much more costly option compared to carting.
- Will require trucks and heavy machinery being on our beachers for 20 years causing disruption to the community and destroying beaches
- Will cost more than double compared to the dredging options
- Will negatively impact businesses and tourism for many beaches
- The 15km pipeline will be embedded through fragile dune and beach ecosystems
- Will cause massive disruption to communities during installation, operation and maintenance
- Will deliver at least 135 cubic metres of nano and microplastic particles onto our beaches and into our gulf waters
- It will lower beachers which are being mined of sand which will put their protective dunes at risk
- Sand grain size at Largs Bay is not large enough to remain on west Beach once it has been deposited.
- It has been wrongly assumed by DEW in the past that sand has been building up at Semaphore and Largs Bay beaches and that mining from these beaches is sustainable into the future. 2022 DEA CSIRO satellite imagery shows this not to be the case and over the last 30 years 30m of beach has been lost from Largs Bay and 70m of beach has been lost from Semaphore.

- Sand which has been carted to West Beach prior to 2023 has not remained on the beach, so a pipeline delivering sand there will have the same result.
Trucks on beaches is not acceptable
Less trucks
Best solution long term
I'm concerned that this option will take a very long time to come online and has the potential to fail as a system as pipelines for sand have done in the past.
Do not support sand carting
Trucks visible on beach
Trucks on the beach is dangerous,
Semaphore south beach doesnt have enough sand. Since the rock break water was put in we have lost 50 metres of beach.
Putting sand in plastic pipe and pumping it will add large quantities of micro plastic to water ways
We know that this works as proven with the Glenelg to Kingston Park pipeline. There would be minimal trucking on the beaches once the beaches are restored to a level where you are only pumping sufficient sand to match the drift
On the fence here. Like the pump idea, but high cost
This has always been the best option. The sand can be pumped to exactly where it's needed along the drift system. There is a massive amount of sand at northern beaches that has accumulated and needs to be used to replenish the drift system south
Too much quarry sand being added to the system, also too much impact on beach use.
Trucks are a temporary inconvenience, and the pipeline is able to move the sand as needed on a permanent basis, at low cost .
Costly infrastructure, inflexible to adapt to rising sea levels, most negative impact on northern coastal communities. Current nourishment onto beach proven to NOT meet international durabiliity metrics. Produces large ampounts of nano-plastics which will be harmful to marine environment. Most costly with marginal to nil benefit.
Added plastic in soil and beach sediment, damage to dunes etc in installing: trucks and other heavy machinery on beaches, and high long term cost. Breakdowns, costly repairs, ugly sights, noise pollution. Glenelg residents found the pipeline has had negative results at beach. View from Semaphore foreshore will be spoilt.
Negative impact to beach users
Least impact on marine environment
- Will require trucks and heavy machinery being on our beachers for 20 years causing disruption to the community and destroying beaches
- Will cost more than double compared to the dredging options

- Will negatively impact businesses and tourism for many beaches
- The 15km pipeline will be embedded through fragile dune and beach ecosystems
- Will cause massive disruption to communities during installation, operation and maintenance, especially at Henley Square.
- Will deliver at least 135 cubic metres of nano and microplastic particles onto our beaches and into our gulf waters as the plastic pipeline perishes over time.
- It will lower Semaphore and Largs Bay beaches which will put their protective dunes at risk
- Sand grain size at Largs Bay is not large enough for sand to remain on West Beach once it has been deposited
- A large portion of sand which has been carted to West Beach prior to 2023 has not remained on the beach, so a pipeline delivering sand there will have the same result. Permanent and constant recycling from beaches north to south is not cost effective and it is destroying Semaphore and Largs Bay beaches.
There needs to be a process involved to compact the sand once it arrives at West Beach. Otherwise, it will just be "swept" away continuously. This isn't a long term, ethical, sustainable solution. It would have irreversible impacts on the planet. Unless these are hydrogen powered / e vehicles, I am very against this option.. Military road and barcoo road are also not designed for heavy vehicle access, there are so many cyclists and runners in the area - creating a significant safety concern.
Our dunes have suffered huge impacts from the combined effects of taking sand from northern beaches and more frequent weather events associated with a changing climate. We were told our foredunes would recover - to date there is no sign of this. Once foredunes are breached - which has already happened in several places, there is increased chance of a total collapse in the dune system resulting in loss of a significant barrier to rising tides, sea level and storm surges and the loss of significant habitat for plants, animals, insects and birds. Our dune care volunteers have contributed hundreds of hours to improving the biodiversity and sustainability of the dunes system from Semaphore South to Taperoo and remain opposed to all pipeline proposals. The pipeline proposal provides fixed infrastructure with a limited life, is not resilient to climate change, produces microplastic hazards, keeps trucks and equipment on beaches with months of the year disruption to beach users and community. Sand from northern beaches is not the best sand for beach nourishment. Trucks and tractors cause damage to intertidal areas and our experience in the past is that contractors have been poorly supervised and/or regulated causing foredune and habitat damage. Our beaches have not recovered from previous sand mining despite assurances to the contrary. Large scarps have formed, foredunes have been breached, plant diversity has been threatened. The operations are noisy, intrusive and don't meet the criteria of being minimal in their disruption. The pipeline options ensure an ongoing sand war mentality along the coast, dividing communities and not achieving ongoing benefits for Adelaide's metro beaches.
This is proven to work in the southern beaches, and it is a solution that demonstrates a long term commitment to the problem.
Same response as option 1.3

This can be done without too much delay
Disruption to the public
Trucking is destructive and too disruptive
Cost effective
less disruption on beaches
less eyesore equipment on beaches/offshore
less turbidity of water
ugly , permanent and disruptive during extensive installment
disruption and costly
Disruptions Expensive
Better option, less intrusive
No comment.
I dont think we should be taking quary sand and disturbing another area.
Would erode the beaches here quicker
As above
Why not recycle sand that has drifted from south to north and utilise trucks and pipeline to do so, and if needed, imported quarry sand. However, the obvious costs are associated with the import of quarry sand.
Most viable long term solution
Fix the beach with sand sourced locally
This option is the current system now successfully operating for the last ten years.
It is difficult to understand that after the number of Adelaide Beach Management reviews from Culver in 1972, through to 1984,1992,1997 and 2005 that Government is carrying out another review
The benefit of using a sand collection machine on the beach is that it can avoid dead drift seagrass which otherwise would impair water quality in the sand discharge.
Recycling sand via the pipeline is the most sustainable use of the finite beach resource, which uses electricity as the fuel source rather than diesel in trucking.
A pipeline has the advantage of being able to add sand to the beach where it is needed, where access by trucks can be difficult.
The presence of the machinery on the beach would be very disruptive for beach users and at four months each year takes too long to have this invasive presence on popular beaches, especially given the work is going to be close to the jetties which is where most beach users congregate.
there must be other alternatives for West Beach other than taking sand from Semaphore beach & destroying our beach

Has been implemented in other local SA areas and is the only proven workable option.
Trucks on beaches doesnt sound good
Sustainable option with assurance of sand and minimising trucking
Trucking sand along the beach is extremely intrusive, noisy and potentially dangerous for beach walkers. A pipeline also would be noisy and intrusive and spoil the natural beauty of the beach environment. The beach along Semaphore and Largs Bay is popular for young families in particular from the North/West of Adelaide.
This would cause irreversible environmental damage for beaches you are taking sand from - these beaches have still not recovered from having trucks on them previously.
This also renders the beaches with trucks on them
Unusable fo northern residents during these periods and has a devastating impact on local businesses.
This option can not go ahead!!!
This would destroy Semaphore and Largs Bay beaches environmentally, socially and financially.
This option MUST NOT proceed!
adversely effects community and expensive
Doesn't disturb seabed
Need to move sand from north to south how this is done needs to not damage/degrade the environment. Do not support dredging.
all of the sand has drifted north
This is only a short term viable option and would need to be used in conjunction with other strategies to slow/retain the sand (pillows/groins/tetrapod's etc.)
No. Disgusting option.
Would decimate the beaches and be devastating
Sounds like an expensive and time consuming solution to implement
Does not damage the sea bed and marine ecosystem
sand is already been lost on the coast, it seems pointless.
it may help
In addition to the truks that will cause degradation to the wildlife and sanctuaries, will cause pollution, noise and public safety concerns...Installation of pipelines and moving the sludge to the beaches in need will require constructions, then pumping stations, diesel generators, etc.
This will also significantly limit the usability of our beaches while the trucks are operating.
Same as above: trucks on the beach, regardless of way of entry/exit will not only be unsafe but also disrupts the environment. On one hand, we protect the birds in the dunes, but on the other hand, we allow heavy machinery noises and vibrations - this is hypocrisy. Moreover, some people may come

to the beach to relax, unwind, improve their mental health - again, heavy machineries will cause disruptions to that.
It is disruptive, and not safe to walk dogs etc when there's trucks on the beach
Significant installation impact then ongoing impact to beachgoers
Very disruptive ongoing , does not address the basic issue adequately, very damaging to environment and very costly
The community as a whole do not want pump stations.
Any trucks on beach too disruptive to beach users and residents
This is technically feasible, can be delivered in a relatively short term, and whilst it has short term impacts on residents whilst the pipeline is being built, from my experience living opposite the existing West Beach pumping station during its operation, the long term impacts on the residents are small. The problems at Henley Beach South can be solved by the proposed sand delivery point north of the Torrens Outlet. Further, I note the draft technical report states that the sand management area had a net positive sand budget, ie the system does not overall require more sand. Thus this solution removes the continual build up of sand deposits in the northern part of the system.
Trucking sand along the beach is extremely intrusive, noisy and potentially dangerous for beach walkers. A pipeline also would be noisy and intrusive and spoil the natural beauty of the beach environment. The beach along Semaphore and Largs Bay is popular for young families in particular from the North West of Adelaide.
this is the best option, it is returning sand from where it is being deposited back to where it has come from. one of the Northern jetties will soon be land locked from sand drift
The pipeline option would be disruptive for beach goers - tractors, trucks on beaches sounds loud and an awful eyesore. Digging up sand making the appearance of the beach unappealing. Installing permanent booster pump stations along the pipeline would be taking g a step backwards. Instead of improving our beaches they would become unattractive to the population in general. Completely oppose this option!
Damaging to the Natural dune ecosystem including flora and fauna. Disruptive, noisy, dangerous machinery on beaches including noisy pumping stations creating eyesore. Impacting on beach use, and possibly local businesses who rely on visitors to the area.
Ultimately this method would not only be expensive, it will also be ineffective. There is scientific evidence to back this up - just as our local councillor who is a Marine Geologist (for goodness sake!!)
Ugly and pollution
as per above.
In the project I did; this option, while most expensive was always the most effective and efficient. Having trucks on the beach is obviously unideal but compared to the environmental and other impacts of dredging it is a necessary evil.
Constant danger and disruption to the community if set up right, this is practical and sustainable and creates a circular eco system

I'm concerned the dredging imagery was not included with Option 2.1 which is misleading. People concerned about dredging could have potentially overlooked this option if they relied on the imagery and hadn't read the description provided in the survey under Option 2.1 which mentions dredging. In addition, dredging for this option is not mentioned in the discussion paper on the shortlisted options. The discussion paper only mentions the delivery of a small annual quantity of quarry sand under option 2.1
While scuba diving I personally witnessed damage caused by turbidity, sedimentation and reef smothering at Port Noarlunga reef due to previous dredging that occurred at Port Stanvac. I am completely opposed to dredging in SA waters because of the environmental damage it causes to coastal, estuarine and marine ecosystems, including reefs, seagrass and benthic marine life. In addition, water quality is likely to be affected and could lead to environmental nuisance where swimming occurs. It will also potentially have an economic impact on tourism and local small business, especially diving companies.
A pipeline is noisy and disruptive, trucks are disruptive and noisy to beach users. Pumps are intrusive and noisy
Expensive and environmental impact. I do not believe the environmental impact has been fully realised.
This is proving to work just south of our beach from seacliff to Glenelg - it is proven so not reinventing the wheel
Worst option .
Returning sand from lateral drift, less environmental impact. Would need to manage machinery on the beach.
It's too disruptive for beach users and destructive of the beach amenity
This disrupts several or many beaches, makes it unpleasant and dangerous for beach users, leaves the donation beaches unsightly and dangerous due to deep furrows which are sometimes unseen due to the water level, impacts our native fauna, does not fix the problem in a satisfactory way.
Not an effective method as beach sand is too fine and wont stay in place where it would be relocated. Also pollution from trucks on beaches
Long term affects of pipeline causing microplastics in ocean. Life of pipeline only 20 years and and cost triple cost of barge which can be ongoing
Expensive and environmentally destructive.
I don't understand how this can be as efficient as off shore dredging and pumping.
We already have a model for this which works so well which they have reduced the amount of fills per year (unless due to storm activity). This is the Glenelg and Seacliff pipeline which along with our middle beaches are the most commonly used beaches of SA. Truck movement is done mainly off seasons with no problems or complaints from locals due to the gentle nature of getting the sand onto the beach in places where needed the whole dune and beach system has thrived. Rare boards (plovers) are stimulated not threatened by placement of a sand slurry and not trucks dumping. This

also would need to be backed up with a mass fill so we can maintain the 1970 sand profile with the pipeline system.
I STRONGLY SUPPORT THIS OPTION, HOWEVER CANNOT CLICK THIS OPTION ABOVE.
This is a proven technology, with a successful pipeline running from Glenelg to Kingston Park. Environmental impact study has already been conducted.
Sounds a bit too complicated and expensive
All beaches north of the Torrens are eroding, so it makes little sense to extract sand from eroding beaches in the face of rising sea levels due to climate change. And it's needlessly expensive
Too expensive
Minimises trucks on beach. Reduces risks to people. Pipeline has proven successful on central southern beaches. Only proven sustainable solution.
Will destroy fauna and flora and make beach unusable at times.
Do not like the idea of using trucks to manage sand cartage as it seems as an inefficient and environmentally unsound way to manage this task
Do not support trucks on the beach as they make a huge mess and it is not environmentally friendly.
If this is used in conjunction with the regular harvesting of "stockpiled" sand at the river outfall then I would strongly support this practical option.
Totally disruptive to beach goers & destructive to dunes
Tractors/trucks/heavy machinery on beaches during installation, operation and maintenance of pipeline will cause maximum disruption to all communities ruining the beach amenities. This will impact beach users, businesses and SA tourism. No beaches will be free of trucks for 20 years. Serious environmental damage including destruction of nesting and foraging areas of threatened species, protective dunes placed at risk of collapse, in excess of 120 tonnes of micro and nano particles delivered to beach face and into gulf waters. There is no way to remove micro & nano plastics once in the marine environment. Sand is of unsuitable grainsize and unlikely to remain on beach. Sand being placed on beach face will steepen beach face and cause more erosion. Very expensive option, leaving little or no money for any future beach management. This option fails all international metrics for renourishment durability and fails all ABMR goals of maximizing sand staying on beaches, avoiding environmental harm and minimizing disruption.
Significant impact on beach residents, users and general amenity
This is my preferred option, as the build up of sand over the years has created huge sandbars and shallow swimming water. You can now walk around the end of the Grange jetty at low tide!
Pretty obvious- eyesore, noise pollution. Northern beach suburbs being punished for a central beach suburb problem. No thanks
Believe this works well in the Glenelg and Seacliff approach
Also will need Mass Fill to get sand on West Beach and Henley beach

Can be micro managed easily ... and would work out cheeper in the long term .. with simpler deliverability, less / no environmental carnage, not a political / community dividerer and little environmental marine decimation.
It works well for Brighton and Seacliff
As a Glenelg resident, but a frequent user of West Beach facilities (esp. Adelaide Sailing Club and the boat ramp), I am very familiar with the pipeline option. This is the most environmentally sound option. Removing the sand from the beach does not affect marine life, and the pipeline does not require hundreds of trucks to drive up and down the coast. The pipeline works, the beach dredging is temporary, and the resultant sand moving is performed in an environmentally sound manner.
Any option that involves trucking and machinery on the beach is very short sighted. Noisy, disruptive, unsightly, polluting. A negative in terms of tourism and the environment. An expensive option for a poor solution.
Trucking quarry sand is the worst idea as it is releasing an extreme amount of green house gasses.
The only viable and sensible option for our coast is to implement the sand pumping option 2.1 as proposed by the review.
I am truly fed up with up to 100 semi trailers trucks of sand driving up and down our beautiful beach and past our sailing clubs and surf clubs every day of the week during sand replenishment programs. This has an enormous negative impact on our clubs activities, to the point where (as one example) we actually need to have in place a risk management plan for our Sailing School activities so children do not intersect with trucks !!! Simply put, sand carting is not a viable or sustainable option for the future.
Effective and reliable
The pipeline is a bad idea and will have a high cost environmental impact on Semaphore and Largs beaches. I strongly do not support the pipeline, trucks, scrapers, collection units and pumps on Semaphore and Largs beaches. I walk on Semaphore beach just about every day. We had trucks and excavators on Semaphore beach collecting sand for carting a few years back and it was a complete shambles. The pipeline just doesn't make sense. This pipeline is a highly politicised solution designed to appease campaigns run by John Dundon and the West Beach mob and it will destroy the northern beaches. Please find another solution and don't destroy our northern beaches.
Best environmental outcome
Noisy plant and trucks on the beach
I oppose the activity of trucks on the beach. Again, I question the futility and ongoing expense of trying to intervene in a natural, dynamic system of Northerly sand drift. Houses at West Beach, Tennyson, Brighton and Somerton should never have been built on the sand dunes.
pipelines cause microplastics and are a waste of money they don't work, pumping stations are a waste of money and ruin the existing landscape, noise and pollution and trucks on the beach is horrible. ABSOLUTE NO
Nurse environmental impact on Sea life

This system appears to work well between Glenelg and Kingston and was the option before the Labor Government reversed the decision.
Absolutely no way - it costs twice as much and the impact to local neighbourhoods and community of building this infrastructure and running it. It will ruin this neighbourhood.
Very environmentally unfriendly to build and vey disruptive to beach goers particularly the sand collection stations and the booster pump stations
I'm concerned the pipeline solution may end up being a "white elephant" - works on paper, but becomes too difficult / costly to maintain and operate.
pipeline would be an environmental disaster
This option is expensive and foolhardy.. It would have a huge negative impact on the dune and beach system for over 14 km's. It would threaten and destroy the delicate dunes. It might appear that there is more sand in the northern beaches but it is disappearing faster each year due to increases storm activity. Those dunes support a delicate biodiverse environment of flora and fauna. It involves trucks on beaches and lack of access for beach users as well as potential danger of huge machines and trucks on the beaches. The sand produced via the sifting, piping etc is like fairy floss and will blow away in weeks. The pipeline will increase micro plastics in the sea and environment. False economy. A waste of money, time and energy not to mention the destruction it will cause. This option is a very bad one. NO NO NO to the pipeline. It should not even be considered. We want to protect all beaches.
We know this work as evidence from Glenelg to Kingston Pk over the 10 years
very expensive to the state and with escalating climate change indicators likely to be ineffective in the near future and actively harmful to the northern beaches.
It will destroy sections of the beaches, be very disruptive during construction. it is likely to contribute plastics to the ocean at a time we are trying to reduce/eliminate them.
Environmental impact, beach disruption, cost
The use of pipelines to transport the sand is costly, but preferrable to trucking the sand by road, notwithstanding the need to temporarily close sections of the beach for sand collection and fluidising. This method seems to have worked reasonably well over recent years, and the proposed northward extension seems sensible.
not affected by weather as dredging activities do
This has been done successfully further up the coast
I'd want to know more about booster pump stations and local impact
This option is expensive and high disruption. Also Quarry sand comes with it's own environmental impacts. Sand from the land should not be used in beaches. I believe it's better to dredge washed away sand from the gulf, but again the environmental impacts are important.
Do not support metro beach mining or piping infrastructure
To much room for error

Definitely not an option!
Only long term solution. Bring the sand that has drifted north back from where it came.
Susan Close will not of course support this option, but she is totally conflicted and beholden to a vocal minority within her electorate.
Absolutely no to trucks or sand carting on the beach. It affects the amenity and safety for beach users
To disruptive to the locals affected by the work scope
this would be a environmental disaster, micro plastic discharged into the gulf, damage to the sand dunes and huge maintenance cost and way too expensive compared to other solutions
This has proven to be effective in pumping sand from Glenelg to Brighton. It is minimally disruptive.
I believe this is an inefficient band aid solution that will have long term detrimental impacts on the Semaphore and Largs Bay sand dunes. It also appears to be one of the most expensive options with negligible outcomes. It certainly will line some companies pocket with taxpayers money.
I STRONGLY SUPPORT THIS OPTION HOWEVER YOUR SURVEY ONLY SHOWS THE STRONGLY DO NOT SUPPORT OPTION OF WHICH I AM NOT AGREEING WITH.
The sand piping from Glenelg to Kingston has proven to be a complete success in rebuilding Kingston beach. Would provide a mass fill from both quarry and piped sand each year. Assessment by EPA has all ready been completed. Would greatly reduce disruption on the beach by trucks at West Beach which has been an ongoing issue for numerous years.
Damaged to the beach
A permanent fixture that will hopefully assist replenishing the sand. Although, no time frame in how long it will take to install the pipeline and what measures will be taken to shift the sand while pipeline is constructed. It what impact it will have on the public using our local beaches while construction is under way.
This would cause immense local disruption and would involve trucks and heavy machinery on the beach and local streets. Noise, dust and the construction of a slurry at the end of our street would destroy our amenity. Not to mention the extreme cost.
Pipleline is the worst possible option, the most expensive, the least efficient and the one least supported by science
This has been successful for the southern beach and the infrastructure is partly already in place at West Beach. Also addresses the environmental concerns that are caused by dredging.
This is a completely disruptive option environmentally and socially, plus is so much more expensive than dredging and carting that it makes no sense to do this at all. It will ruin the northern beaches, be an eyesore (collection points and trucks / machinery at many places on the coastline), remove sand from northern beaches that cannot afford to be lost (as beaches already receding), and it has been shown that much of the sand taken to West Beach and other nearby areas in need doesn't

even stay there as the northern beaches' sand is too fine in particle size that it isn't efficient. Quarry sand may remain, but not sand eg from Semaphore and Largs Bay.
Options 1.1, 1.2 and 1.3 look to be much less environmentally, socially and economically damaging overall than this option.
This option will be perpetual and will perpetually ruin our beaches, making them undesirable to visit, or to engage in all of the usual beach activities.
Ludicrous shirt sighted costly plan that will have dire impact on flora fauna residents and beachgoers. Inflexible and ridiculous to install all that infrastructure and heavy machinery to take sand from one point / community to one other point/community. Has proven negative impact on sand dunes
My overall preference is NOT to Dredge OR use a Pipeline - both are reactive solutions to the problem. My overall preference is to address the root cause of the issue (Climate change, Increasing Storms and Wave Movement) and create an artificial reef or breakwater ~1km offshore. Addressing the cause, not the symptoms is my strong preference.
Nevertheless, I have selected 'Support' as this for the following reasons: Tractors/trucks/heavy machinery on beaches during installation, operation and maintenance of pipeline will cause maximum disruption to all communities ruining the beach amenities. This will impact beach users, businesses and SA tourism. No beaches will be free of trucks for 20 years. Serious environmental damage including destruction of nesting and foraging areas of threatened species, protective dunes placed at risk of collapse, in excess of 120 tonnes of micro and nano particles delivered to beach face and into gulf waters. There is no way to remove micro & nano plastics once in the marine environment. Sand is of unsuitable grainsize and unlikely to remain on beach. Sand being placed on beach face will steepen beach face and cause more erosion. Very expensive option, leaving little or no money for any future beach management. This option fails all international metrics for renourishment durability and fails all ABMR goals of maximizing sand staying on beaches, avoiding environmental harm and minimizing disruption.
There are many unanswered questions about the pipeline as a solution. My real fear is that all the CPB's efforts to grow dunes along the metropolitan coast will be upended by the massive machinery and invasive need to bury the pipeline along newish dunes. These have taken 10-15 years to get to this state. Is it worth damaging them for a pipeline that might only have a 25 year working life? It does not solve the problem of climate change and seas rising - all of which provide unpredictable risk factors for a stable engineering piece of infrastructure. What happens when you come to popular seaside locations such as Henley Square and south where there is really nowhere to bury the pipeline?
As a Professional Engineer who has worked in a maritime industry for more than 30 years, I know that a pipeline system would be continually breaking down and would require excessive costly maintenance throughout its life. Further, a pipeline would cause ongoing enormous disruption and safety issues to all coastal communities. I have reviewed publicly available pipeline documentation and have concluded there are numerous flaws in its entire concept, viability and ability to deliver required sand. There is no consideration of climate change impacts. I have also learned of the

negative environmental impacts of a pipeline i.e. generation of tons of micro plastic particles into the sea.
Having experienced sand carting on our beaches I Strongly object to heavy machinery on the beaches on social environmental and safety basis Also note higher estimated cost without considering social and environmental costs Can you imagine the outrage if thus machinery was on Glenelg or Brighton beaches ?
Tractors/trucks/heavy machinery on beaches during installation, operation and maintenance of pipeline will cause maximum disruption to all communities ruining the beach amenities. Due to climate change we are seeing higher tides, more frequent storms and sea level rises. These impacts will result in delays and cost blow outs during the construction and installation of the pipeline. The installation and delays will impact beach users, businesses and SA tourism as will the sand collection and processing activities. The installation of the pipeline also runs right through the historical and cultural landscape of the Kaurna people, the traditional custodians of the Adelaide plains.
No beaches will be free of trucks for 20 years. Serious environmental damage including destruction of nesting and foraging areas of threatened species. The lowering of beaches due to sand collecting activities will put protective dunes at risk of erosion leading to collapse which in turn will put infrastructure & properties at risk. there will be in excess of 120 tonnes of micro and nano particles delivered to beach face and into gulf waters from the abrasion of the 14 km HDPE pipeline. There is no way to remove micro & nano plastics once in the marine environment. The sand is of unsuitable grainsize and a carbonate composition. Due to carbonate sand's tendency to readily break down the sand will be unlikely to remain on beach, especially on West Beach where the revetment wall is exacerbating erosion and there is no suppression of wave action. Sand being placed on beach face will steepen beach face, causing more erosion. This pipeline option is a very expensive option, leaving little or no money for any future Adelaide beach management, or money for other coastlines in SA. As we have seen from the 100,000 cubic metres of heavier quarry sand placed on in the same position on the beach face per year, 80,000 cubic metres has been washed away. (DHI 2023) Therefore this option will fail to deliver its desired outcome.This option fails all international metrics for renourishment durability and fails all ABMR goals of maximizing sand staying on beaches, avoiding environmental harm and minimizing disruption. If a cost/benefit analysis was undertaken on this very expensive, ineffectual and environmentally damaging pipeline the costs to the community and businesses, the environment and 14 km of beaches would far outweigh any benefits of the pipeline's outcomes.
The pipeline has a proven and successful methodology and long term success within the southern beaches along the Adelaide metropolitan coastline. The sand sources are known and available (within sustainable volumes if undertaken correctly). This solution is permanent and long term and will ensure the ongoing nourishment of all beaches within the management cell. We do recognise that there will be some community impact through sand collection on the northern beaches and also in the depositing of quarry sand on the southern beaches.
Potential benefits

Results in appropriate sand nourishment for the southern beaches
The pipeline has proven to work in the southern management areas beyond West Beach
The solution and structures are permanent
The offshore impacts are minor in comparison to dredging
Potential risks
Ongoing and frequent disturbance for beach users and residents in the northern and southern beaches
Structures located within the beach environment may result in reduction of visual amenity of not designed and located appropriately
The location of the pipeline should be appropriate so as to not cause irreversible environmental damage to the established dune system
Microplastics are a likely result of the pipeline deterioration over the longer term
The annual nourishment volume (post mass fill) needs to be at least equivalent to the littoral loss rate of Cell 3 being approximately 115,000m3 per annum
Pipeline sounds feasible, but cost is hight
The coastline and sand supplies from the beaches has already declined significantly making a pipeline untenable. The mere presence of trucks and tractors causes damage to the environment and incidents with people and animals will soon follow.
expensive. damaging to beach. disruptive
As previously stated, sand mining is not back by scientific literature
Scrapers and Trucks on the beaches impact on the beach and the erosion of the dunes - I have experienced this and am strongly against this - It results in destroying one beach to try and repair another
I strongly disagree to using the beach akin to a quarry
Environmental damage to the dunes which will be caused by the construction
Environmental impact of trucks
Microplastics pollution
At risk from sea level rise
Relatively inflexible
Additional permanent infrastructure along coast
Too many unanswered questions regarding impacts of climate change / sea level rise. What would be the impact on the beaches being dug up for sand for the pipeline and being dug up for installation of the pipeline?
No trucks. there is already enough sand on the northern beaches, why access the quarries its completely ridiculous

Destroying beaches to temporarily replenish others does not work and does not make sense.
Proven. Kingston to Glenelg pipe line. Coolangatta pipeline, to name a few.
Proven, longterm, sustainable.
There would be political opposition to this proposal so I cannot see cabinet support.
Again, does not allow for an initial mass fill for West Beach.
Onshore sand is too fine and trucking it to locations hasn't been working in past years and a permanent expensive pipeline won't change that. It is very destructive when there is machinery on the beach and building infrastructure could cause environmental harm, besides building them will be noisy and disruptive. Options 1 and 2 provides a better more flexible way to do what is needed. The Point Malcolm sandbar trial was made too permanent before its issues could be seen. We always believed that the shoreline would cut in a lot further than they thought it would when it was originally discussed.
Less impact on marine life
I walk the beach every day: trucks on the beaches disturb and distress every person, animal and bird. I have seen them driving much too fast for our safety. The proposed pipeline outlets would be at the end of a greatly used walkway from the car park area and Largs sailing club.
Why? Tractors/trucks/heavy machinery on beaches during installation, operation and maintenance of pipeline will cause maximum disruption to all communities ruining the beach amenities. This will impact beach users, businesses and SA tourism. No beaches will be free of trucks for 20 years. Serious environmental damage including destruction of nesting and foraging areas of threatened species, protective dunes placed at risk of collapse, in excess of 120 tonnes of micro and nano particles delivered to beach face and into gulf waters. There is no way to remove micro & nano plastics once in the marine environment. Sand is of unsuitable grainsize and unlikely to remain on beach. Sand being placed on beach face will steepen beach face and cause more erosion. Very expensive option, leaving little or no money for any future beach management. This option fails all international metrics for renourishment durability and fails all ABMR goals of maximizing sand staying on beaches, avoiding environmental harm and minimizing disruption.
There would appear to be a body of evidence that the northern beaches are also suffering some degradation so should not simply be relied upon as an ongoing source of sand.....this would appear to be an expedient but somewhat short sighted view.
This is the only option provided that is not just a "desk top review". This has been successfully implemented on the southern beaches for a number of years so it is an option that shows the success of proven working model.
As this is an option that had already been scoped and investigated, it shows that when re-reviewed it is a sound and practical option. It is understood that necessary approvals for this option are aready in place (until June 2024).
This option would also minimises trucks on the beach and also enables sand to be moved from areas of build-up to areas in need of replenishment due to erosion (so sand can be recycled within

the coastal system and minimise the need for more expensive quarry sand). The option also provides the flexibility to adjust amounts of sand and direct as required.
This option would also reduces the build-up of sand on the northern beaches which in turn would reduce the impacts of sand build-up (eg landlocked jetties). Unlike dredging, impacts are "visible" and can therefore be addressed as required.
This option is strongly supported as it will ensure sandy beaches ALL along the coast.
Everything about this looks awful. The intrusion on the beach, both for recreation and environmentally. The cost. Placing permanent machinery in the middle of some of Adelaide's most beautiful coastline. Can't imagine a worse option.
This is current practice
Beach sand needs to be managed. I am happy for the experts to determine the best way.
Lower likelihood of dredging being required, and if it was then it would be on a relatively small scale.
This is the best alternative for marine life.
Tractors and trucks on beaches in an inflammatory statement. We need to share the pain across all of the coast. This should be kept to minimum in all cases.
This is a system which is proven to work around the world
It is not at the whim of Government
We can see the destruction at Semaphore beaches due to this practice and environmental advice is that an increase in big storms will further increase erosion. This is not a sustainable practice
Pipeline is expensive and has limited lifespan. It is noisy and impacts on the local environment. It is visually ugly. Trucks are still needed on the beach to feed the pipeline which causes ongoing damage to the environment and prevents the community from using the beach. The sand from the northern beaches is too fine and is washed away from areas such as West Beach at the first storm.
Pipe line will permanently affect the same area negatively and no recovery time
Trucking has already reduced the height and depth of the large sand dunes within 2 years!
Entirely destructive and disruptive to all beach users but mostly it's natural inhabitants leaving the beach in a state of unnatural disrepair for years to come. Why oh why would you take from one part of the beach (destroy) to replenish on a TEMPORARY basis another part of the beach.
If it was pipeline it would be the better idea but trucks pollute and compact the beach and a obstacle for beach users
A pipeline is too damaging for the coast, too expensive, and is not flexible - it is better to go with dredging which can be changed within a few years if actually needed, rather than locking in a 20-year expensive and damaging pipeline project.
I've seen and been on the beach with monster trucks.
Someone will be hurt or killed with this option.
Ugly, disruptive and noisy for those of us who use the beach most.

Returning some sand south where it came from
Turns the coast into an industrial zone, dangerous and unsightly.
Keep vehicles off the beach
Far too disruptive, expensive and totally unsuitable
Same as option 1.3
Does not impact sub sea habitats and deposits sand on the beach where it can slowly make its way offshore
How to destroy a coastline natual dunes and protection from climate change. Destructive unpleasant not sure why it is on the list.
Heavy machinery on beaches during construction as well as ongoing. Beaches will be impacted by trucks, ect for decades. Very expensive option.
This must stop
The damage to semaphore south and semaphore shoreline is obvious
It has created beaches not safe to walk on
Huge truck tracks in sand massive holes in beach
Uneven dangerous surfaces
Disfigured coastline from one beach to create beauty at another .
This creates unusable beaches. I went on West Beach when there was just one truck going up and down, and it the beach was all churned up like a ploughed paddock, and no-one can sit on a beach with a truck and scraper going up and down it.
There would be pumping stations, and other structures. No-one wants them in front of their houses, It would diminish the value of their properties, and be an eyesore on the beachfront,
There would be noise. Constant noise.
There would be diesel fumes.
The critters that live in the sand would be killed, destroying the balance of life in and on the sand.
Where this option has been used overseas, it has mostly been spectacularly unsuccessful.
The buried pipeline would cause damage to the flora nd fauna that that taken decades to establish.
I heard that for some part it would be buried under the footpath. What a waste of time, effort and money. It seems to me, that someone, without environmental knowledge, had a task to do do, and said, "I know! Lets bury a pipeline straight through the dunes and under the footpath. It's probably the easiest and cheapest way!" Even those of us without proper scientific and environmental knowledge can see that this is a thoughtless and ignorant thing to do.
Concerns about impact of sand carting on our beaches and impact on marine environment of pipeline, plus the cost, make this unattractive.

The collection of sand from beaches will have a detrimental environmental impact on those beaches and dunes. The construction of the pipeline and its associated infrastructure will be highly disruptive to all communities along its path. Micro-plastics will be deposited into the ocean and beach areas. Cost is the biggest and therefore less flexible. Pump stations and cooling towers will impact local residents and visitors to the area.
• This is not a desk top review.
• This has been successfully implemented on the southern beaches for several years.
• This has been scoped and investigated with the necessary approvals are in place.
• Minimises trucks on the beach.
• Enables sand to be moved from areas of build-up (glut) to areas in need of replenishment due to erosion
• The amounts of sand can be adjusted and directed as required.
• Recycling sand in the system rather than taking from other areas, which can in turn create environmental issues and impacts.
• Reduces the buildup of sand on the northern beaches, which are in huge surplus and are experiencing landlocked jetties.
• Any impacts during implementation are visible and can be addressed ie dune restoration, and opposed to impacts during dredging which are not as visible.
• Will result in sandy beaches all along the coast.
Disruption to nothern beaches and will have longer term nnegative enviromental inpacts
Have already seen how much damage the trucks & scraping do to the beach, intertidal zone, dune faces. Pipeline would cause additional damage to the dunes
The sand is too fine, it is a major disruption to Northern beaches, there are major negative environmental impacts. There is not one positive thing about the pipeline apart from taking trucks off of West Beach! West Beach is not a major attraction point, with no jetty, main strip, or community grassed areas - unlike Semaphore beach. Semaphore is a major/popular beach, attraction, and meeting location for many families and communities of the Western and Northern suburbs. Semaphore holds decades of history and is well loved by many in Adelaide. Having trucks, sand carting, or a jetty closed will stop many from continuing with their daily recreational and calming activities like walking, fishing, meditating, running, bike riding, and so many more. I don't understand why you would want to ruin a very popular, major beach to save a beach with no major history, recreational activities, or popularity to SA. I urge you to perform a survey of those that attend Semaphore vs West Beach throughout the year... this may cause you to rethink this decision.
1. Any sand taken from Semaphore, Largs and Taperoo beaches is not being 'replaced' at a reasonable rate. There does not seem to have been any consideration of replacing sand on these beaches when they have been ruined.

2. Pipeline infrastructure is large, noisy and makes sections of the beaches permanently unusable. This is unfair to beach users, and is not a solution which considers the longer term.
3. Pipelines required trucks on the beaches permanently. This is unacceptable.
Strong environmental and local amenity disruption.
Too disruptive and a waste of money. Sand is too fine on the northern beaches and will have drifted back within 12 months
Pumping sand is highly damaging to the environment.
Too damaging for Semaphore and Largs Bay. Ugly collection points, unsafe loud trucks, and damage to the coastal environment.
The disruption to our beaches would be horrendous
It is a plastic or similar pipeline carrying course materials that will leach into the sand and ocean. An eyesore for residents and visitors. Disruptive to community and wildlife. Loss of habitat for wildlife.
Will create more erosion and damage infrastructure + be a safety hazard to beach users.
It won't work and it will ruin what is already here, and people have put in a lot of effort to reinstate and maintain.
Support the trucking, just has to be completed through the cooler months
What a horrible way to ruin our local beach. Unsustainable to save west beach you will ruin semaphore
I saw this happening at Glenelg and wasn't bothered by it.
Costly infrastructure required which will damage northern beaches and fragile dune systems , Inflexible to adapt to rising sea levels, Trucks on beaches with large impact on northern coastal communities, Produces unacceptable, large volumes of abraded plastic pipeline microplastics to the marine environment over its life time.
Most invasive to beach and environment - microplastics from abrasive action of sand on pipe. Permanent structure which allows less future adjustment.
Pipelines would destroy the dunes, introduce more plastic into the environment which is unacceptable and trucks turning the beach into a highway instead of tranquil place of wellbeing is deplorable.
Against both a pipeline and trucks on the beach. Pipeline - I can't begin to imagine how a pipeline would impact our beaches [noise; structure being visible and being an impediment to beach access, etc]
Trucks - I already know how trucks on our beaches spoiled the use of our superb recreational asset, when that was happening.
This is a truly awful option for northern beach residents and beach users
I was one of six respondents that gave qualified support to an earlier survey on the proposed pipeline (I recall there were almost 200 against the proposal at that time). My research since then

has now placed me strongly against the pipeline proposals. While this research is limited it has involved a review of the discussion paper, the draft Technical Report and some other papers associated with coast management, mainly addressing the Dutch experience with sand nourishment for dynamic coastline conservation.
The pipeline options during construction, installation and operation will be highly disruptive to communities and beachgoers
The pipeline options will require trucks and tractors to be on beaches for the next 20 years both collecting & delivering sand to the pipeline. It will still require additional sand from quarries to be delivered
Hard engineering structures like pipelines are the most inflexible and don't adapt to the changing impacts of climate change such as sea level rise
The pipeline options will do environmental harm to the 14 km of beach and dunes. The abrasion of the HDPE pipeline will deliver additional nano and micro plastic particles on to the shore and into our gulf waters.
The pipeline options are the most expensive option at $140-155 million and will not deliver the outcomes for which it is designed. It fails all of the Adelaide Beach Management Review goals of maximising sand staying on beaches, avoiding environmental harm and minimising disruption to communities
Do not like pipeline idea as it is more expensive and introduces micro-plastics to the sea
Pipeline would place micro and nano plastics on the destination beach and then into the Gulf. Sand directly onto the beach will
Not stay there. Would destroy sand source beaches and dunes. Very expensive and ineffective option.
Firstly, it's now scientifically clear that all the metro beaches have been suffering erosion over the last decade or more as a result of higher tide levels and more frequent strong storms apparently driven by climate change. To follow a strategy of further depleting several metro beaches to 'plug holes' in one or two seems madness. Onshore and near-shore environmental damage will increase rapidly. Secondly, construction of a pipeline will entail significant damage to the dune system, and the life it sustains, for the many kilometres from the northern beaches to West Beach. Thirdly, the financial estimate for this option is unappealing to taxpayers and presumably to government. Fourthly, but also crucially, this option 2.1 involves serious disruption to community enjoyment at the beaches where the heavy machinery and pipeline pumping stations operate. This affects the income of the many local businesses which rely a great deal on visitors to the beach.
Significant impact on many local beaches. Previous trucking on beaches has damaged and compacted beaches
Pipeline
1. HARMFUL AND DEVASTING LONGTERM IMPACTS TO OUR COMMUNITY. THREATENS THE FOLLOWING -

a) Loss of tourism, loss of community space, loss of community well-being due to invasive and destructive annual practice of quarrying sand from beach or near shore areas.
b) Negative Impact to local businesses of Semaphore and Largs Bay during winter when business is marginal at best (i.e., role of beach, dunes and foreshore in visitor economy and supporting local business activity)
c) Damages the role of the Northern coasts in identity of place (i.e., activation of beach and community activities in dunes and foreshore)
d) Loss of Public safety (i.e., truck movements on beaches at 40kph equal to Semaphore Road, excavations on beach and intertidal zone);
e) Loss of Public amenity (i.e., noise, truck speed, beach closures and nuisance impacts);
f) Detrimental to Natural environment and increase in coastal erosion (the removal of sand from the beach and tide zone creates a relative sea level rise by localized lowering of beach, storm surges then destroy dunes because the ocean can reach them).
g) Accelerates threats to local infrastructure by destroying our first line of defence from storm surges – beach and dunes
h) Loss of beach/jetties access for sports, leisure, and mental health
i) Accelerated coastline loss, dune recession and destruction
j) Impacts to flora and fauna (environment)
k) Increased Noise and air pollution from trucks, pumps, excavators
l) Works against nature, invasive, destructive
m) Impacts to local recreational fisherman and crabbers when considering extracting from around jetties or between jetties.
n) Pollution and health risks from nano plastics created from transporting a quartz slurry thru a PVC pipeline
o) High capital costs that impact community as taxpayers
p) Not flexible meaning the damage will be unsustainable and ongoing until project failure/termination/abandonment. Internal sand has proven ineffective in maintaining and sustaining West Beach. nd there is no modern evidence that Northern beaches are receiving sand from West Beach, in fact the coastline is now eroding.
A pipeline will wreck our northern beaches. Too expensive for dubious outcome. Tractors/trucks on beaches are already spoiling the environment. Also, the impact of more man-made and intrusive structures is too costly to the environment
I don't support the Pipeline options because of the significant environmental impact that this permanent structure will have when being build in the dunes or along the beach but also when it will be used with all the detrimental effect of micro plastic for example and not to forget what we would also legate to the next generation when this infrastructure will arrive to its end of life.

This is also a very expensive option with a number of technical downsides (transport of fine sand that don't stay on the beach, limited sources of sand where it will be taken on the Northern beaches while this sand is needed to protect the coast there against the increased storm pressure).
A more sustainable system compared to the others. Proven system on the southern Adelaide Beaches.
Short term and costly solution
It is a no brainer
Environmental damage will increase rapidly.
It is now scientifically clear that erosion is occurring along the entire coast because of higher tides and more frequent storms.
Depleting several beaches to temporarily provide sand for one or two seems quite insane.
A pipeline will cause significant damage to the dunes.
Financially far more costly.
Dreadful disruption to community enjoyment of beaches.
A drop in income for many local businesses.
A pipeline is NOT a solution. Plastic pipe = micro plastics straight into beach, environmental impact, trucks on the beach, maintenance costs to taxpayers, LOSS OF SAND FROM LARGS!!
It will involve closing beach to dig pipeline, and is worse for the environment. Also disruption for residents
This method is relocating, the sand back to its original location complimented with quarry sand for percentage losses. I still do not support dredging as a source of complimentary sand.
More of the same !! Get rid of the Breakwaters @ Semaphore and West Beach!
Trucks still on the beach. Sand only collected from designated areas leading to degradation at those sites. Direct deposit of sand onto beach less likely to remain on beach. Expensive
Our beaches are not lesser beaches and we deserve unimpeded noise free beach time. Please do not take sand away from our beaches to put on another beach on the same coastline; This is not a solution but band aid.
a disgraceful option that will damage the environment and not be cost effective
Trucks and heavy machinery will be ruining our beaches for 20 years. This damage to our beaches, inability for locals and visitor to enjoy and use the beaches safely, impact on local businesses and economies and the enormous cost is totally unacceptable. It does not make any sense on any criteria and is just plain destructive.
Results in appropriate sand nourishment for the southern beaches
The pipeline has proven to work in the southern management areas beyond West
Beach. The solu on and structures permanent

The offshore impacts are minor in comparison to dredging
- The environmental damage of building the pipeline would be irreversible - impact to sand dunes and local coastline
- Information from Digital Earth Australia (DEA) shows Semaphore and Largs have actually LOST sand since 1988, furthermore the sand is fine and does not stay on West Beach
- DOES not take trucks of beaches
- 3-4 months of the year the beach would be subject to trucks and heavy machniery on beaches - who would make a decision to do this on popular beaches that are used ALL year round (Semaphore and Largs), how can this be considered an equitable solution
- The pumping stations would be noisy, ugly and impact local residents and businesses
- Long distance to pump sand, the cost of running let alone the environmnental impact of running and maintaining would be totally ridiculous
- Has the impact of the plastic deposits from the pipeline into the ocean been considered and what this would do to our ocean species
- Pipeline is the MOST EXPENSIVE option by far
- Maintaining the pipeline and pumping sand would be a huge cost and massive impact to the local community and South Australians that frequent the beaches where the sand is being 'harvested'
- Pipeline DOES NOT FIX the problem for beaches loosing sand it is just a solution to Rob 'Peter' to pay 'Paul' at a significant environment and community cost
- Nothing positive about the pipeline solution
Pipeline
1. HARMFUL AND DEVASTING LONGTERM IMPACTS TO OUR COMMUNITY. THREATENS THE FOLLOWING -
a) Loss of tourism, loss of community space, loss of community well-being due to invasive and destructive annual practice of quarrying sand from beach or near shore areas.
b) Negative Impact to local businesses of Semaphore and Largs Bay during winter when business is marginal at best (i.e., role of beach, dunes and foreshore in visitor economy and supporting local business activity)
c) Damages the role of the Northern coasts in identity of place (i.e., activation of beach and community activities in dunes and foreshore)
d) Loss of Public safety (i.e., truck movements on beaches at 40kph equal to Semaphore Road, excavations on beach and intertidal zone);
e) Loss of Public amenity (i.e., noise, truck speed, beach closures and nuisance impacts);
f) Detrimental to Natural environment and increase in coastal erosion (the removal of sand from the beach and tide zone creates a relative sea level rise by localized lowering of beach, storm surges then destroy dunes because the ocean can reach them).

g) Accelerates threats to local infrastructure by destroying our first line of defence from storm surges – beach and dunes
h) Loss of beach/jetties access for sports, leisure, and mental health
i) Accelerated coastline loss, dune recession and destruction
j) Impacts to flora and fauna (environment)
k) Increased Noise and air pollution from trucks, pumps, excavators
l) Works against nature, invasive, destructive
m) Impacts to local recreational fisherman and crabbers when considering extracting from around jetties or between jetties.
n) Pollution and health risks from nano plastics created from transporting a quartz slurry thru a PVC pipeline
o) High capital costs that impact community as taxpayers
p) Not flexible meaning the damage will be unsustainable and ongoing until project failure/termination/abandonment. Internal sand has proven ineffective in maintaining and sustaining West Beach.
- The environmental damage of building the pipeline would be irreversible - impact to sand dunes and local coastline
- Information from Digital Earth Australia (DEA) shows Semaphore and Largs have actually LOST sand since 1988, furthermore the sand is fine and does not stay on West Beach
- DOES not take trucks of beaches
- 3-4 months of the year the beach would be subject to trucks and heavy machniery on beaches - who would make a decision to do this on popular beaches that are used ALL year round (Semaphore and Largs), how can this be considered an equitable solution
- The pumping stations would be noisy, ugly and impact local residents and businesses
- Long distance to pump sand, the cost of running let alone the environmnental impact of running and maintaining would be totally ridiculous
- Has the impact of the plastic deposits from the pipeline into the ocean been considered and what this would do to our ocean species
- Pipeline is the MOST EXPENSIVE option by far
- Maintaining the pipeline and pumping sand would be a huge cost and massive impact to the local community and South Australians that frequent the beaches where the sand is being 'harvested'
- Pipeline DOES NOT FIX the problem for beaches loosing sand it is just a solution to Rob 'Peter' to pay 'Paul' at a significant environment and community cost
- Nothing positive about the pipeline solution
Extensive disruption to coastal communities and businesses. It is not flexible and is high cost

No trucks on any beaches. Not acceptable.
appreciate that the analysis is grounded in scientific principles specific to the Adelaide beaches, rather than relying solely on examples from elsewhere in the world. A locally tailored approach is often more effective.
The fact that there is already a successful pipeline in Adelaide serves as a proof of concept, demonstrating that the technology is feasible and effective.
aims to create a sustainable solution by redistributing sand from where it naturally accumulates to areas where it is needed. This promotes healthy beaches along the entire coast.
I recognize that there may be short-term challenges or disruptions, but believe that the benefits of this approach will be felt for generations to come. This long-term perspective is essential for the preservation of the beaches.
more disruptive to the public and damaging to the environment
Tractors/trucks/heavy machinery on beaches during installation, operation and maintenance of pipeline will cause maximum disruption to all communities ruining the beach amenities. This will impact beach users, businesses and SA tourism. No beaches will be free of trucks for 20 years. Serious environmental damage including destruction of nesting and foraging areas of threatened species, protective dunes placed at risk of collapse, in excess of 120 tonnes of micro and nano particles delivered to beach face and into gulf waters. There is no way to remove micro & nano plastics once in the marine environment. Sand is of unsuitable grainsize and unlikely to remain on beach. Sand being placed on beach face will steepen beach face and cause more erosion. Very expensive option, leaving little or no money for any future beach management. This option fails all international metrics for renourishment durability and fails all ABMR goals of maximizing sand staying on beaches, avoiding environmental harm and minimizing disruption.
Excavating the beach is very bad for beach goers and tourism. Ugly infrastructure is bad.
Best way to continue operations without being de-funded
Proven methood
Most efficient. Least environmental impact
By creating permanent infrastructure protects our beaches from future de-funding
Environmental vandalism pillaging sand from one area to replenish another. Trucks and other machinery disturb the tranquillity of the beach and turn it into an industrial wasteland.
permanent infrastructure needs to be developed to protect the beach management from future de-funding
The most obvious reason is we have a working accepted pipe system in use between Glenelg and Kingston with costs known, and no opposition from the residents during its operation.
Sand moves from sth to Nth is not in dispute so it fills in in the northern beaches.
The only Sand that is already accessible and acceptable for use

Sand on the beach has no cost until it is pumped and then is the cheapest method of beach restoration and replenishment
There is already the known volumes of sand on the northern beach required to reinstate and supply west beach
The pipe ensures regardless of policy it will be used by future governments
Shares the burden of managing the coast as a whole across all beaches and suburbs
Is placed on the beach on the dry so not as susceptible to littoral drift and acts as a better buffer to storms.
Least environmental impact
The pipeline options, i believe are the most disruptive to all communities from the source of the sand ,i.e. Largs and Semaphore, and for the 7 transit communities to West Beach.
At Largs and Semaphore-sections of the beach will be closed, which negatively impacts beach users and the visitor economy.Views will be impeded and sea views are an asset. This will be in place for four months every year for 25 years, which is unacceptable
Permanent bulky pump stations on the esplanade are aesthetically unappealing and will be at each of the transit sites. At Henley Beach they will be in very close proximity to homes and businesses. There is nowhere on the esplanade to hide it. This is different to the Holdfast Bay where in the main they are hidden.
Permanent Infrastructure for 25 years-little flexibility in the face of climate change, sand delivery points or innovations in the industry.
Environmental harm from micro plastics from the plastic pipeline and disruption to our dunes flora and fauna and trucks on beaches.
Delivery of sand near shore, as per the dredging options, is considered more effective, but this will be placed on shore.
More expensive than dredging options
as above
This option does not disturb the sea floor and it's residents.
My understanding was that an environmental impact assessment was to be done on the pipeline option. Has this been completed?
The best option and already proven to work on our coastline provided a mass fill initially included.
Reduces and reuses built up sand north.
Continuous supply of sand.
I regularly fish the beach (4-5 times a week on average).
From West Beach through to Tennyson. I also collect beach worms through this area.

In doing this, I observe the beach, its sand and the sands movement, probably a lot more than others as this is what defines the sand bars, gutters, depths that I fish. The location I fish depends on these factors.
I notice where sand has gathered and has declined, I spot erosion before others and notice build up.
Areas I fished regularly to the north now have too much sand and some species no longer visit. This increased year on year for a decade.
Additionally sand carting to West Beach makes the area unfishable for several months a year, gutters are filled , random profile lost. The imported sand has no marine organisms. This area once held one of the biggest densities of beach worms, but now they are scarce.
No marine organisms in the sand , feeds up through the food chain. Less fish follow.
The West Beach section once was the best stretch of beach to fish along the Adelaide coast. Sadly no longer.
Of all the options I believe the sand pipeline will be the most consistent, recycling sand with microorganisms within them.
A great benefit for many for some minor disruption to a few.
Because of information I have read from Save Our Shores (SOS)
Terrible to see what's happening at Glenelg with noise and equipment and trucks and beach fenced off for many months of the year. It seems to be getting longer each year. Also theres other very ugly bulky equipment near the playground. Not a good idea for Semaphore-bad enough at Glenelg
This option cannot go ahead. It is extremely damaging to the dunes, is not a long term option and will create destruction during its installation, operation and removal. This option has received continued angst for good reason and the community must be listened to. You cannot put something of such hard infrastructure through what are extremely weak and fragile dunes home to endangered species and plants. This option also does not take trucks off the beach. In conversations with residents around the existing pipeline have expressed their disgust regarding noise and visual pollution and overall dissatisfaction from the pipeline. Do not allow this option to happen. Listen to the community, please.
I do not support collecting sand from northern beaches and destroying these beaches to fix West Beach.
The pipeline will be costly, noisy and needing ongoing maintenance.
I do support using trucks to distribute quarry sand
This is the only feasible option. It is proven to work on Adelaide's southern metropolitan beaches. The pipeline has already been planned, designed and obtained the necessary environmental and other approvals. It is thus ready to go and can be completed in six months.
Already successful pipeline being used in SA. This has worked between Glenelg and Seacliff.

Pipeline is going to damage dunes. Too expensive. Water waste. Heavy machines on the beach. Lots of trucks. Short lifespan. Northern beaches are eroding already without harvesting and pumping sand
I do not support the pipeline option
Noise and machinery
Heavy vehicles should not be on sensitive ecosystems or public recreational areas
I do not support the need for heavy machinery on the beach.
Damage nature
How is this even an option??? Everyone that agrees with this should be sacked. This is outrageous. A massive environmental disaster the whole length of Adelaide beaches. You guys have rocks in your head. What a MASSIVE waste of money. Your staff need to do more research, as there is a much better way than this ridiculous option.
I lived at Somerton Park. The pipeline there was an effective way to manage sand with minimal disruption to beach users

Please explain your level of support for Option 2.2 - Pipeline using fixed jet pump systems on jetties

This option has on-going emissions production from a boat and truck powered by fossil fuel. A fix needs to be i place that has little or any on-going work or labour requirement. Also visual and noise impacts.
would not want to impact any fishing
Our jetties are a treasure. To block them for considerable periods of time makes no sense. It may however be feasible if it were instead a small barge located near the jetty connecting to a pipe under the jetty. Given the cost over off-shore dredging this makes little sense though.
So, you want to dredge around jetties? What will that do to the jetty pylon foundations I wonder?? Probably wreck the jetties fairly quickly.
What science was used for this option I wonder?? Forget it, its impractical on many levels
Wasteful.
on data presented :
- very high cost (Estimates are selection phase so little engineering completed to get to better than +/- 50%
- impact on local residences and beach goers
- damage to jetties
- restricted access to jetties

- large environmental and social impact
Support what ever is required to maintain a usable beach.
Cost, jetty usage disruption
Don’t think submersible pumps at the end of the jetties would work, be cost effective and or produce the volume of sand required. This will not address the current sand build up on the beach itself at Semaphore.
Jetty systems would have a low impact on the beach and beach users but the trucks may impact beach users.
Dredging from jetties is an astonishing option. Jetties are there to be used by people and the presence of large machines will disrupt people's use of them. Further, dredging is environmental vandalism.
There is no information on the effect of this option on Semaphore and Largs beaches. The sand is less than optimal for replenishment at West Beach and will wash away very quickly.
Closing the jetties for 4 months is totally unacceptable - find another way.
Too much infrastructure and would take too long.
Seems a bit complicated
Significant cost, less disruptive than carting/feeding pipeline along the beach but nevertheless significant reduced amenity.
Moving sand already destined to going on shore.
Price and don’t think we need to build infrastructure
Once In place the government of the day will use the infrastructure as required and it minimises trucks on the beachs .environmental it uses the least amount of fossil fuel to move the sand to the locations it is needed at when it is needed
This will further damage Semaphore beach and dunes, they need time to recover before more sand is harvested. The rock barrier has caused scouring of the dunes to its north and trucking sand has caused significant erosion of the dunes to the South of Semaphore jetty.
Jetties would not be up to this task. Disruption to jetty users. Plus we need to avoid trucking except for stop gap measures.
Complicated, subject to failures, expensive
Irresponsible, carbon intensive , ineffective
inefficient and limited quantity of sand available in immediate vicinity of the jetty. Also would create large silt plumes and impact jetty users
Good method, however I question if Adelaide jetties are long enough to get enough depth for collection
Trucking sand through suburbs is the worst possible solution! Please don't take this option!
No trucks

Quarry sand does not belong on beaches. The environmental effects need to be considered ahead of people's desire to have sandy beaches.
Much better solutions available. This is an embarrassing environmental message to the world.
Jetties are for people to enjoy
Digging up the beach to lay a pipeline is costly, unsightly, noisy and destructive.
Noth to south movement should work
this process would alienate jetty users as well as beach users. Why would you try to disturb so many at such a high cost
intrusive
Trucking is intrusive to beach users
Not only ruins beach but also jetties which are tourist attractions, used for fishing and recreations. Eyesore. Destroys our dune system.
Seems likely to disrupt seagrasses near shore and affect jetty fishers
Trucks on the beach at West Beach are only good for the sand carting company dollars.
Most inconvenient to beach goers and the Plovers that are supposed to be protected
Environmental damage. Quarry sand is not beach sand
This will cause a lot of disruption to beach goers and tourism and damage marine life around the jetties
Sounds awful. Nothing on the jetties.
Quarry sand component is not sustainable and cost effective
Return the sand to the southern end - especially Hallett Cove!
I have witnessed the long term success of this at both the Tweed River Seaway and Gold Coast Seaway. Sand otherwise tends to accumulate making the water more shallow. Such system captures part of the near shore drift that may not otherwise happen.
Heavy machinery in the middle of our tourist attractions. Unsightly, and short sighted. Turning recreational spaces into mine sites is not the answer.
Jetties are important for recreational use
it would be expensive and intrusive, tapping into a limited resource on a regular basis... perpetuates all of the problems of the pipeline, just with fewer trucks but probably more social impact because it could have the effect of closing our much loved jetties to members of the general public for extended periods just so you can trickle feed sand on to the beach at West Beach and the finer it gets, the faster it erodes, the faster it returns, the faster you can send it back the other way in a never ending cycle that just keeps speeding up! Also, hard infrastructure to remove when it wears out or starts becoming less and less effective over time.
A jetty based dredge system seems like an eyesore. If we're going to dredge, do it off shore.

No evidence of sustainability / concern of available resources over decades to maintain this work / impact on environment
Booster pump locations in specific sites should be supported , I do not support it in conjunction with Quarry Sand
A long term more efficient solution. Ability to operate across the year.
There was not sufficient information in the discussion paper to make informed input. There was no assessment of environmental impact of options or carbon emissions impact. There was no long term system change options presented. There was no explaination of why other options were not assessed. The options represent status quo and are not suitable options.
Large trucks on the beach are dangerous. I do not support mining dunes for sand
No pipeline required. just dredge
This would be terrible for tourism.
Why should taxpayers continue to pay for bad engineering and inappropriate development
Waste of money
Damages the beach
Our jetties are icons in south australia. Why
You will wreak the source beaches to try and 'fix' another beach. Hugely disruptive to the source beach. There's still damage to the beaches of Largs North and Bay from earlier work.
Sounds a bit full on. Need more info.
This will remove jetties from being a social gathering point due to noise and area restrictions and create a hazardous area around the water in these areas
1) cost
2) disruption
3) use of trucks
We have to work with nature and not keep fighting against it . Leave the sea floor alone . Let beaches disappear and let other beaches grow .
Support local communities
Possibly but again not supporting trucks on the beachs
I support a pipeline and permanent infrastructure as it is less likely to be the subject to political funding and beurocracy. Quarry sand should only be used until the beach profile is healthy.
This would have negative impacts on swimming, fishing and and general aesthetics of the jetty area, creating murky/dirty water, a dangerous swimming environment and noise pollution. As well as making the jetties unsightly which would impact tourism/visitors to the area
Environmentally devastating! Economically and socially devastating for northern beaches.

Significant Environmental concern for local northern beaches and financial concern for northern beaches businesses
This option has not worked anywhere else. Causes the most harm and disturbances to beach goers and nearby residents.
Keep operations away from jetties.
eyesore
Pipeline will lead to unsustainable amounts of sand taken from northern beahes. SAND IS NOT BUILDING UP on northern beaches - evidence shows it is being lost.
Community protests will become extreem due to degredation of beaches (including dunes) and limited access to jetties.
Direct damage to jetties is possible and increased vulnerability to storms likely.
Trucks on the beach are an OH&S risk to the local community.
Would disrupt beach and jetty use and disturb water/ affect water quality close in around jetties. Noisy and polluting.
Jetties are areas of important sea life and tourism and local fishing.
As above
Restricts use of jetties, unsightly, undermines jetty piles.
Once again you are using the wrong sand source.
It has to be far offshore preferably from Port Stanvac end.
The quarry sand is still good.
See above. Pipelines are a bad idea. What are you attempting to create(?) because all you are doing is destroying what already exists.
This option is hard to believe.
Again the pipeline itself is flawed in so many ways, please see previous question.
Semaphore and Largs Bay are tourist beaches and used by many members of the community daily and there are numerous businesses close to the jetties. To close the jetties off for 4 months of the year is totally ludicrous. People swim, fish, bring their children and dogs to the beach for well needed rest and recreation on and around the jetties. The noise, turbidity, inability to access the beach via the jetties and jetties themselves is unthinkable.
I totally disagree with a pipeline. The impact this would have on all part of the beaches including the environment, dunes, marine life and the flora and fauna.
The cost to do this is very expensive.
see above
This seems like the worst aspects of multiple solutions pulled together.
Adelaide shores should never have been built

Trucking sand from quarries is expensive & disruptive. Pumping sand from near jetties could undermine them. Buried pipelines are expensive to intall & maintain.
Short term solution only with disruption to beach users.
Do not want trucks on beach
Inclined to let nature do it's own thing
These jetties are iconic, much loved community infrastructure which are used by all visitors to the northern beaches. pipelines and cables with dredging around the jetties is unacceptable.
Concerns about safety of trucks around kids in beach. It's hard to handle already when the trucks have been there. Also when sand is piled onto the beach sometimes there are voids underneath that some people can fall into- already seen them myself - and it's pretty impossible to keep kids and dogs off the piles or hills
Jetties should be for people to enjoy
see section2.1
No trucks or junk on jetties
Disruption and damage to beach
Affect on water quality and access to jetty while in operation would be problematic.
It would affect local beach users, and consequqently tourism and businesses.
Far too complicated, avoid pipeline.People enjoy fishing and walking along a jetty, do not need fixed pumps
As above dredging better and cheaper
Impact on beach users during the process is high
Nonsense jet pumping from jetties or along the beach. Much simpler to excavate at low tide. Collection process is total waste of money.
Negative this option does not incorporate mass-fill reinstatement.
Delivery by pipeline of sand is ACCEPTABLE, -pipeline strongly supported but collection is nonsense.
Sand ultimately placed at West Beach in the dry zone and not tidal area, or -2m AHD, ensuring community benefit prior to entering into littoral drift.
Disruption is eliminated at West Beach.
This is just crazy...
This is the best long term option and although higher capital cost should be more sustainable.
Lose access to jetties on my beaches to fix issues with other beaches. No one makes a new problems to resolve another one's. Also stupidly expensive.
Expensive and still needing truckingp
wont removing the surrounding seabed sand upset the marine life in area (blue crabs). And once removed would the sand from the shore just fill in the void just created

Similar reasons as given to Option 2.1. This is simply a terrible, expensive idea.
Impacts beach environment and restricts pedestrian access to jetty and beach. The creation of the pipeline and its ongoing use will impact residents. Appears to be a very expensive option.
ABSOLUTELY NOT! My previous reasons for objecting to anything but dredging out to sea presumably do not need to be repeated. Scraping our beaches, as witnessed has been hideous enough!
A huge machine at the end of a jetty both visually and audibly - where many people are drawn to walk and many fish from - might not look quite as bad as the disgusting mess our beaches were left in with dirty salty pools and trenches left by huge tyres - often deeper than knee-deep - making it dangerous for many to get to the water's edge - would never-the-less hardly encourage many from wanting to visit the Adelaide beaches, so far held dear and even vital to many.
THE DESTRUCTIVE AND BANDAID SOLUTION OF A PIPELINE HAS BEEN DISCUSSED!
So disruptive and visible. Would stop people fishing on the jetty.
Jetties should have focus on recreation
Appears inferior to dredging only, given the reasons previously articulated. Again it appears to be an unnecessary hybrid.
Terrible option - pollution, disruption, terrible use of resources. STRONGLY OPPOSE!
There will be extra stress on jetties with the attachment of a pipeline systems. There will be sea grass and ecological damage to the environment due to this practice.
There is no mention of what would be the environmental impact to set up this pipeline...
noisy polluting trucks and pump engine.
what about the wildlife that lives under gettys, people could get hurt, too much construction, overall stupid
Same as abiove.
Pipelines are proven to work
I feel very strongly that the decision on how to treat our beaches must NOT be in the hands of just anyone. These decisions must be made by people with marine and environmental science expertise. We need to use the best system according to what the science says to help fix and protect our beaches.
Expensive long term
Avoid trucking options due to public disruption
Opposition from jetty users. Hazard to jetty users.
The same reasons as my previous answer. Also we are now experiencing more ferocious storms so the pipeline will ultimately be exposed anyway. Semaphore and Largs jetties are a big draw card for visitors and the locals as I undertstand it they will need to be closed for several months of the year when the pump is operating.

Too expensive and intrusive
Too much sand at Largs North
Keep the same sand going around as far as possible
May damage the foundation of these jetties
A very expensive and disruptive option! Semaphore and Largs jetties are used by the community all year. This option requires closure of the Semaphore and Largs Jetties for 4 months every year. This, with absolutely no benefit for the local community that is being most impacted. NO.
The same applies to this solution. This option does not meet any of the three requirements of the solution. It causes horrendous disruption for Semaphore/Largs communities and all of the many thousands of Adelaidians that use these beaches. Clearly the trucks are not removed from the beaches and roads and heavy machinery present on two of the states most popular beaches would be astoundingly backward. There is massive amounts of erosion along these beaches and the latest DEA data proves these beaches are shrinking and cannot be used as a sand mine for West Beach. The sand mined is fine and does not stay on the beaches and it is massively expensive. It amazes me that the pipeline solution is still even discussed it's that much of a discredited solution.
Trucks are dangerous on the beach. Piping creates ugly, polluting and unnecessary infrastructure. Destruction of habitat inevitable in establishment of pipeline
This would be a very intrusive option. It would be better to collect sand at low tide. The amount of sand under the jetties is enormous and needs to be removed. At the West Beach end the sand pipe needs to be installed in the high dry area. If placed in the tidal zone, then the sand could be caught up in littoral drift, thus removing any benefit to West Beach.
Polluting and illogical
Ditto to previous question. No pipeline is worth a temporary expensive fix for permanent environmental damage and loss of lands, access and amenity.
For similar reasons as last question- The costs for the pipeline have blown out, very expensive, the destruction to the dunes system to build the infrastructure. The jetty's would need to be closed for 4months of the year to the general public, these are the favourite spots of the coast for beach goers and families. Unsightly machinery and pipes close to the popular spots of the coast to visitors and locals.
It would help more ship  go through
Not sure on this one.
I cant imagine how this can be environmentally acceptable.
As mentioned earlier: the missing sand form West Beach and other areas is obvious and available on Largs Bay and Semaphore Beaches. You dont need to take from any other location.
Don't want pipes near the jetty
Very ineffective way to catch sand and worry about disturbing the clean water at Semaphore & Largs Bay.

Noise and disruption to beach use. Short term fix
Environmental concerns
Very ineffective way to catch sand
shocking to destroy the beautiful ambience and cultural environment of this cultural and environmentally significant part of area.
See response 15 above.
Dont think closing one of our beautiful Adelaide jetties which is popular with many many families for a period of time is a viable option
This also limits the location of where sand can be collected from to be piped...
$$
see previous
Dont want trucks on the beach disrupting beach goers--the pipeline is ugly
see response to 2.1
I oppose heavy equipment on jetties and beaches for obvious reasons! The beach is for the community, not heavy equipment. I oppose sand carting for reasons stated above (heavy trucks rattle my house). I also oppose the collection of sand from Semaphore region as, even though in your info material it states otherwise - there is a very REAL problem of erosion at Semaphore beach. It's clearly eroding and getting worse when its being taken from Semaphore South, the sand is not able to build up at Semaphore beach itself.
Social, noise, safety, level of disruption and cost. Disruptive infrastructure on jetties, collection stations and trucks on beaches
Stupid
Unattractive for northern beaches
Unsure if viable option. Longshore drift is built up on the coastline of northern beaches
Anything
Dredging from the seabed is an environmental issue. Also the use of jetties is not ideal
Thanks very much for making my area the 'solution' to someone else's problem (sarcasm!) It should be 'hands off' the peninsula beaches unless the problem is locally based.
To much disruption of sea bed and visual amenity. Likely to place restrictions on water activities near jetty.
Need a permanent, fixed option.
Pipelines are very ugly laying on top of the sand at the beach
Same argument as for option 2.1 with the added impact on recreational fishing that utilises the Semaphore and Largs Bay jetties. This is a terrible solution not much better than 2.1
See comments to option 2.1

It is hard to believe that this is a viable option.
Lost jetty access is an unacceptable imposition on the community.
The impact on the long-term integrity of jetty structures as a result of sand harvesting must surely be a risk of real concern.
Heavy environmental, community impact, low benefit and only to one beach, risks to community users, extremely expensive option
Would this result in the jetties being off limits to the public? It sounds like an expensive and intrusive option.
Don't agree with trucks & machinery on beach
Closes jetties for months affecting beach amenity. The grain size and composition are unsuitable as feed for a pipeline as significant carbonate component will break down into silt, Unsustainable with rising sea levels, pipeline produces significant volume of micro plastics, delivers sand only onto the beach which is only a cosmetic effect and very temporary failing all international metrics for renourishment durability. Expensive.
Disturbing seemed near jetty will affect the marine life and they are great for snorkeling and enjoying. A crane sounds unsightly too and building a pipeline will disturb the dunes.
Is this a joke?
Not only have you already allowed an Olympic sized swimming pool to be dug under the Largs Jetty but you are now proposing to close the Semaphore Jetty for 3-4 months of the year and drive heavy machinery up and down it. These jetties are heritage listed. I mean, really!
Idiotic, myopic & smacks of class war via social privilege. Appropriate & uncaptured / independent expert analyses indicate this the worst option.
We gotta do better than this...& we can!
Huge disruption to beach use, including species that live in the sand
Disrupt jetties
No pipeline wanted.
Destroy jetty access and dangerous for jetty users
The jetties play an important role for recreational purposes. Having a crane and dredging operation on the end of the jetties would disrupt quiet enjoyment of the jetties. Also, trucking should be avoided.
Dredging sand is NOT an option due to destroying (smothering and choking) reef and seagrass habitat. Dirty water blocks sunlight and so kills seagrass. Thick silt cover kills healthy reef habitat.
We have already lost 80% of seagrass along metro Adelaide. Dredging would reverse the increase in reef and seagrass health
Seed for Snapper project - fishers
Waste water - Bolivar

Greenfeilds wetlands /recycles water
Shell reefs
Option 2.1 Pipeline (supplemented with carting sand from Semaphore) will effectively manage sand on Adelaide's beaches in a way that minimises disruption for communities, avoids environmental harm, and maximises sand staying on beaches.
If we are moving sand for our own enjoyment of beaches and protection of our homes and infrastructure then we need to accept disruption to our lives - not expect marine life to suffer as a result of our needs and wants.
External sources of sand, quarries - where are they located? Where are future sand quarries located?
Am firmly opposed to all pipeline options. Costs are huge, and dredging shows much more flexibility and more cost effective.
I want trucks off beaches
Same as 2.1 but with the added disruption on the jetties. this option takes away beach use for a large portion of the year and cost a lot more.
Expense and emissions.
Our jetties are used for recreation, the areas around them would be the busiest on the beach; this would impact visitors
This option is not cost effective and would be intrusive on suburban jetties which are enjoyed by many beach visitors.
Disruption to beach users & unsightly infrastructure.
Again what are the environmental impacts? I support the option with the least negative impacts
As stated I oppose machinery on the beaches. Restricting access to jetties will impact negatively on local users, visitors (including tourists) and associated business and economy.
Definitely do not want to see a crane on either jetty. Disrupts the beauty & tranquility of the landscape. Residents have paid a premium to live near the beach, & others travel to enjoy it. This option will affect those that come to fish from the jetty's
There would be a massive impact on and degradation of the beaches from which the sand is sourced.
There would be a huge negative impact on visitors and residents of the beaches from where the sand is extracted. The abrasion of sand inside a plastic pipeline would eject nano plastics into the marine environment. All the beaches between the collection point and deposition point would be excavated for said pipeline which is an abhorrent notion. The compaction of our beaches by heavy vehicles will also be disastrous for the beach ecology inc disruption to bird life, macro invertebrates, disturb the natural hydrology of the beach and contribute to increased frequency of localised higher tides. The sand in situ at proposed collection points is a natural line of coastal protection to assets owned and utilised by visitors and residents. We cannot afford to reduce our beaches in view of

climate change and the increased frequency in king tides and storm activity. Beaches MUST be protected.
The review does not consider the effect of dredging on the offshore environment
As Nos 16 reponse
This option is using the best long term sand resource, which is the northern beaches (Semaphore Largs etc) and utilise pumping as the primary delivery method which has the lowest impact and a reasonable recurrent cost
it seems like it would work.
Expensive, destroys the environment, disrupts usage of beach, unsightly and dangerous for beach users
Inefficient and expensive method of securing sand. Could potentially also disturb the ocean further North away from the outlets.
See comments to option 2.1 It is hard to believe that this is a viable option. Lost jetty access is an unacceptable imposition on the community. The impact on the long-term integrity of jetty structures as a result of sand harvesting must surely be a risk of real concern.
Returning the sand from West Beach to West Beach seems like the only way to maintain equilibrium. I know that long-shore drift is a thing, however, as a community we have built on the sandhills (at WB and generally) and if those sandhills erode, a lot of the city will be underwater.
I don't really understand where, exaactly, the sand is collected here. Or the risks.
However, as long as sand comes back to WB, from northern beaches, I am happy.
this sounds like an eyesore for jetty visitors, not to mention the damage to sea bed and wildlife around the area
Disruptive, visual pollution, impact on semaphore beach /jetty visitors. Trucking and dumping quarried sand has already proved disruptive and ineffective.
I think that seagrass detritus will be a significant problem for pumping systems at this location particularly if depressions form around the pump intakes.
Closing the jetties for 3 to 4 months I believe will be unacceptable to the local community.
This method minimises disruption to all beaches. The certainty of the dredging location at the Jetties means that full use of other locations along our beaches can be preserved,
Presumably the use of quarried sand (via trucks) can be minimised, particularly if both Semaphore and Largs jetties are a source of off-shore sand?
This option is favoured as an outcome with the least disruption to the majority of community members.
any sand mining off shore especially around jetties dose not make any sense to me.

Interfering with the environment will be a never ending waste of time, resources and money, which can be better directed by the Government into more productive areas such as Hospitals, Roads and Schools.
Damage that would be caused to the marine habitat
For sand collected from Semaphore and Largs Bay beaches:
- Will require trucks and heavy machinery being on our beachers for 20 years causing disruption to the community and destroying beaches
- Will cost more than double compared to the dredging options
- Will negatively impact businesses and tourism for many beaches
- The 15km pipeline will be embedded through fragile dune and beach ecosystems
- Will cause massive disruption to communities during installation, operation and maintenance
- Will deliver at least 135 cubic metres of nano and microplastic particles onto our beaches and into our gulf waters
- It will lower beaches which are being mined of sand which will put their protective dunes at risk
- Sand grain size at Largs Bay is not large enough to remain on west Beach once it has been deposited.
- It has been wrongly assumed by DEW in the past that sand has been building up at Semaphore and Largs Bay beaches and that mining from these beaches is sustainable into the future. 2022 DEA CSIRO satellite imagery shows this not to be the case and over the last 30 years 30m of beach has been lost from Largs Bay and 70m of beach has been lost from Semaphore.
- Sand which has been carted to West Beach prior to 2023 has not remained on the beach, so a pipeline delivering sand there will have the same result.
A submersible dredge pump attached to a crane or a long reach excavator at the end of Semaphore or Largs Bay jetty requiring the closure of the jetty to the public for 3-4 months each year would cause massive disruption to jetty and beach users. Jetties and beaches support tourism, walking, recreational fishing and swimming.
Damages community amenitie
Leave the jettys alone
Dredging not good for environment
I don't agree that sucking sand up from a fixed position around the existing jetties is a good idea.
Do not want to see trucks carting sand in the suburbs I've paid $3million dollars to live in...
Our jetties are for the public not a quarry Plastic pipe add micro plastic to water
Once again, I doubt that the environmental study will enable the issuing of a licence for the dredging from the end of either jetty. It would necessitate the closing of both jetties for prolonged periods and the fishing community will be heavily opposed
Keep the jetties open

Like the excavator and pump idea, not so fussed about trucking. Reasonable strategy but High cost. Don't understand the need for additional of quarry material.
Providing it's safe for marine ecosystems yes. There is so much accumulated sand at these northern beaches this could work and be less intrusive
Ruins the recreational use of jetties for people, and also impacts the marine life that uses the jetties as their homes. Will have a significant negative effect on local road I frastructure at the beaches' busiest spots.
Dredging near jetties is a crazy idea, disruptive to the seabed, and the little fishing still available for recreation now.
Costly infrastructure, inflexible to adapt to rising sea levels, most negative impact on northern coastal communities. Current nourishment onto beach proven to NOT meet international durabiliity metrics. Produces large ampounts of nano-plastics which will be harmful to marine environment. Most costly with marginal to nil benefit.
NO TO PilPELINES
Negative impact to beach users
pipeline good, trucks bad
This option
- will cause outrage to the community especially those who use the jetties and nearby beach.
A submersible dredge pump attached to a crane or a long reach excavator at the end of Semaphore or Largs Bay jetty requiring the closure of the jetty to the public for 3-4 months each year would cause massive disruption to jetty and beach users. Jetties and beaches support tourism, walking, recreational fishing and swimming.
- Will cost more than double compared to the dredging options
- Will negatively impact businesses and tourism for many beaches
- The 15km pipeline will be embedded through fragile dune and beach ecosystems
- Will cause massive disruption to communities during installation, operation and maintenance
- Will deliver at least 135 cubic metres of nano and microplastic particles onto our beaches and into our gulf waters
- It will lower beaches which are being mined of sand which will put their protective dunes at risk
- Sand grain size at Largs Bay is not large enough to remain on west Beach once it has been deposited.
- Sand which has been carted to West Beach prior to 2023 has not remained on the beach, so a pipeline delivering sand there will have the same result.
It would have irreversible impacts on the planet. Unless these are hydrogen powered / e trucks, I am very against this option.. Military road and barcoo road are also not designed for heavy vehicle access, there are so many cyclists and runners in the area - creating a significant safety concern.

Closing a much used public facility like Semaphore and Largs Jetties to the public for 4 months of the year does not meet the criteria of minimising the impact on these local communities, bearing in mind that combined these 2 beaches are the most used. Not only does this pit communities along the coast against each other but it further divides the local community - how will 'jetty users against beach users' play out locally? What consideration of numbers of jetty users has been undertaken? What model of community tolerance has been applied or will be applied to properly assess the impact of this option? To date we have been presented with no evidence that this takes in to consideration the social impacts of this option. It is purely an engineering fix and unacceptable. My concern (already expressed at the forum but unanswered) is does choosing a 'winner' come down to a numbers game. We were told voting on the options on the evening of the forum was only an 'indicative exercise'. The 'harmony along the coast' so passionately spoken of by the Independent Panel Chair will not be achieved by choosing this option.
Ridiculous idea where the dredge would take take the sand from the jetty foundations and the whole lot falls in to the sea
Trucking is destructive and too disruptive. Jetties are for recreation. Cannot see how use of jetties could be beneficial.
restrict beach access and destroy coastal harmony of environment and sounds
disruption and costly
Less intrusive
No comment.
As per previous answers, i dont think we should quary, and im not convinced about the amount of sand avaliable around jetties it would disturb fish??? Long term impacts to fisherries,
Also digging up the shoreline and blocking jetty use along the coast for several months at a time.
Would erode the beaches here quicker
All of the above.
This option does not seem viable or well thought out as it will create other issues that will have to be dealt with as well as destroying crucial offshore sea beds, as well as affecting the use of the jetty for recreational fishers and other jetty users.
Why would you close a jetty ??
This disrupts other beaches and other areas
Investigations for the Sand Pipeline considered extensive trials of available sand collection devices. (See Planning Report for the Sand Transfer Infrastructure Project ALB Appendix D).
Jet Pump arrays on jetties at Tweed Heads and Southport operate in deep sand and high littoral drift successfully in the absence of high volume dead drift seagrass, which is prevalent on Adelaide beaches.
The systems at Southport and Tweed Heads are for sand bypassing, whereas the system proposed in this Option is for backpassing sand south to counter the littoral drift north.

The period of operation suggested in the Option, 3 months, would not be able to access enough sand delivered to the jetty by littoral drift over a year.
The depth of sand at Semaphore and Largs Bay is shallow, being 2 metres or less, requiring significant mobility of the pump.
Depressions caused by the sand collection would quickly fill with dead drift seagrass creating further contamination of subsequent dredging operations. The use of a macerator on the pump would increase water quality impairment.
This option would require a storage of sand equal to a year's littoral drift perhaps in an excavated sump, but not without the problem of dead drift seagrass.
Marine Industries used a pump equipped with a macerator on a crane to lay a pipeline at Christies Beach. Despite operating between sheet pilling and a narrow opening to the sea, significant clogging of the pump occurred.
It is not acceptable to close the jetties for 3-4 months each year. These jetties are well used and it would be too much of an imposition on beach-goers.
Not sure about dredging option.
Less disruption to beaches and environment
Too much infrastructure
Strongly do not support. A pipeline would be costly, intrusive and noisy.
This would cause irreversible environmental damage for beaches you are taking sand from.
This also renders the beaches and jetties with cranes on them unusable for northern residents during these periods and would have a devastating impact on local businesses.
This option can not go ahead!!!
This would destroy Semaphore and Largs Bay beaches environmentally, socially and financially.
This option MUST NOT proceed!
yuck!
Don’t want cranes snd dredging pumps on the jetties and don’t want to disturb seabed
Concern that dredging will cause damage to sea bed and water quality.
anti dredging
un stabilized seabed is part of the problem, doing more damage is a short term fix with worse long term consequences
No. Not close in. Horrible idea.
Would absolutely decimate the beaches and be devastating to everything on or near beaches
Doesn't sound like a long term sustainable option?
Damages the seabed and disrupts the delegate marine ecosystem
costly dangerous and an eye sore

does not solve the problem
Adding to the previous options, dredging sand from the jetties will cause significant dislocation and ocean plant life that will end up on the beaches. Hobby fishing from the jetties will be affected and the ocean life will be impacted.
Absolutely not. Please do not transform lovely relaxing young family suburbs into industrial areas. Moreover, you will discourage anyone (many) from the north and north-eastern suburbs coming to these beaches (their only option of not traveling 30+ minutes from home). You will not only upset the locals, but extended communities using these beaches.
I don't think a dredge pump would be nice for the dolphins. The jetties are very busy too so I don't think a crane on the jetty would be ideal
Get job done, costs and inconveniences unknown
Jet pumps, pipelines, quarry sand? Just not right on so many levels.
See above (2.1)
Negative environmental impact on marine life.
Again too dispuptive to recreational beach users
Have no understanding of the feasibility or effects of using fixed jet pump systems on jetties, so cannot comment.
Do not support any kind of pipeline to move sand.
damage to sea floor and excluding the public from jetties is a bad idea.
NO NO NO! Absolutely no pipelines or machinery on our beaches. Look at how it ruined Glenelg! Noisy, disruptive, environment destroying and ineffective
Expensive and looks flaky
robbing Peter to pay Paul. no sense
I did a school project on this exact issue and all the information I found said that the short term gratification (cheaper cost) of any dredging based proposal would not be worth the long-term environmental impacts and with this proposal we've spent all the money on the pipeline anyway.
Minimal disruption and sustainable. More effective and economic in total terms than other options.
I'm concerned the dredging imagery was not included with Option 2.2 which is misleading. People concerned about dredging could have potentially overlooked this option if they relied on the imagery and hadn't read the description provided in the survey under Option 2.2 which mentions dredging. In addition, dredging for this option is not mentioned in the discussion paper on the shortlisted options.
While scuba diving I personally witnessed damage caused by turbidity, sedimentation and reef smothering at Port Noarlunga reef due to previous dredging that occurred at Port Stanvac. I am completely opposed to dredging in SA waters because of the environmental damage it causes to coastal, estuarine and marine ecosystems, including reefs, seagrass and benthic marine life. In addition, water quality is likely to be affected and could lead to environmental nuisance where

swimming occurs. It will also potentially have an economic impact on tourism and local small business, especially diving companies.
Noisy Disruptive Ugly
Expensive, unsightly, impact to environment, community and businesses
Not the right solution
Stirred up sand in an ecologically sensitive and highly popular beach? No way!
Against dredging due to environmental considerations.
Strongly opposed to this option
Another option that disrupts the enjoyment and beauty of our beaches and now the jetties. Possible danger to users from the crane and noise issues.
Enviromental impact on beaches wildlife, people and businesses
Long term affects of pipeline causing microplastics in ocean. Life of pipeline only 20 years and and cost triple cost of barge which can be ongoing
Jetties will be ruined
Expensive and environmentally destructive.
Again, I am unsure how this can be as efficient as off shore pumping.
Very ineffective way to catch sand and worry about disturbing the clean water at Semaphore & Largs Bay.
Dredging would have a high impact on the coast. Unlikely that this proposal would receive EPA approval.
It is not known whether there is a suitable sand deposit available.
Depositing sand near the shoreline would impact water turbidity.
As above
These jetties are used all year round, are heritage listed and constructed of eroding timber piles. Putting heavy machinery here, while deepening the surrounds makes no sense . A this option uses a pipeline it's ridiculously expensive.
Too expensive
Second best option. Pipeline solution has proven successful on central southern beaches
Building will destroy fauna and flora. Fixed jet pumps are eyesore and take away from the natural surroundings.
Don't like the idea of a permanent crane on either of the jetties
Do not support trucking sand.
There is a better option that is so obvious to anyone who has any knowledge/experience with our beaches. It's NOT rocket science.

This option will close jetties for months disrupting the communities that use them. The grainsize and high carbonate composition of the sand will break down to silt and result in sand not staying on beaches but being washed into gulf waters in the form of silt plumes which could choke seagrasses. This option is unsustainable with rising sea level rises and will also result in high quantities of microplastics being washed into the sea. Once in the sea, there is no way to remove micro & nano plastics in the marine environment. Placing the sand on the beach face will cause the beach to steepen, causing more erosion. This option fails all the international metrics for successful renourishment and durability and will cause environmental harm while not fulfilling the purpose for which it is being suggested.
Significant impact on beach residents, users and general amenity
Per option 2.1
Hard to catch sand this way
Can't be micro managed as easily ... and would work out dearer in the long term .. with regard to deliverability, environmental carnage, a greater political / community dividerer / interferer and limited sand source ... without inevitable environmental marine decimation.
Trucks should be avoided
The discussion paper does not mention tucking. If this option dod not involve trucking on the beach, it would be the best option potentially, with no trucks or dredges. A system of offshore pumps, which could be powered from solar sources, is potentially the best option from a sightliness and sustainability perspective.
This again will not solve the problem.
A crane on Semaphore and Largs jetties is a terrible idea. Please don't do this. I strongly do not support a pipeline.
.
Used a pipeline system
I am worried about disturbance of the sea floor, and possible loss of sea grass. I don't like the fact that the jetties would be closed during sand collection. Again, I question the futility and ongoing expense of trying to intervene in a natural, dynamic system of Northerly sand drift. Houses at West Beach, Tennyson, Brighton and Somerton should never have been built on the sand dunes.
its a waste of money because it wont work. the pipes cause microplastics. between the pipes and the trucks you'll have ruined the jetty AND the beach. This is the worst "solution" I've ever heard of. ABSOLUTELY NO.
As per previous answer.
This option puts cranes on the jetties as well as trucks and other machines on the beach and more pipeline which just means more plastic in the sea as it slowly but surely degrades.
Just very ugly having a crane sat on the end of the jetty. Also same concern about a pumped sand system not working as expected.

Oh let's destroy the jetties as well.!! This option is expensive and foolhardy. Oh the pipeline again!!! Only this time we won't be able to access our jetties for up to 3- 5 months a year. Which happen to be used for recreation, tourism and other community activities all year round. It would have a huge negative impact on the dune and beach system for over 14 km's as the pipeline will still need to be buried underground. ("buried under the beach") It would threaten and destroy the delicate dunes. It might appear that there is more sand in the northern beaches but it is disappearing faster each year due to increases storm activity. Those dunes support a delicate biodiverse environment of flora and fauna. It involves trucks on beaches and lack of access for beach users as well as potential danger of huge machines and trucks on the beaches. The sand produced via the sifting, piping etc is like fairy floss and will blow away in weeks. The pipeline will increase micro plastics in the sea and environment. False economy. A waste of money, time and energy not to mention the destruction it will cause. This option is a very bad one. NO NO NO to the pipeline. It should not even be considered. We want to protect all beaches.
It is very expensive to the state and with escalating climate change indicators likely to be ineffective in the near future and actively harmful to the northern beaches.
It will destroy sections of the beaches, be very disruptive during construction. it is likely to contribute plastics to the ocean at a time we are trying to reduce/eliminate them.
in addition it will create turbulence in the water impacting people and fish.
Environmental impact, beach disruption, cost
I know that jet pumps and other submersible pumps on jetties are used in Queensland and other high energy coasts where there is a good depth of sand and a consistent alongshore sand movement. These conditions do not apply at Adelaide, and this method cannot be considered here. We have only a thin skin of sand overlying clay, and our alongshore drift is intermittent, with a relatively large proportion occurring during storms. Catchment basins would need to be excavated in the clay (causing turbidity and seagrass damage) and, even with these, the supply of sand into them could not be relied on. Also, local experience indicates that dead seagrass would collect in these pits and that this can be a major impediment to dredging. I have already commented on the use of trucked quarry sand as a last resort if a suitable external offshore source cannot be found.
Will get DIT to maintain the precious jetties! Just saw the news report on the atrocious condition of Edithberg jetty
See previous on dr3dging
The dredged sand is too close to shore, which will have more environmental impacts on seagrass beds and marine life, though this information hasn't been presented.
Do not support metro beach mining or infrastructure. Impact of beach environment.
Might be good
Definitely not an option!
Not a practical solution.

Absolutely no to the use of jetties for collecting sand as it would affect the amenity and current uses of the jetties
To disruptive to the locals affected by the work scope
Totally against the objectives of the panel, disruptive to the community and the structural integrity of the jetty will be compromised. A disaster waiting to happen.
It may be OK, but I don't know enough about its impact.
This solution appears to be a short term solution with no real long term gains. Most disruptive to the environment, the local residents and beach users and one of the most expensive options with the potential to cause long term problems at Semaphore and Largs Bay.
It would be much simpler and easier to excavate sand at low tide. This option does not incorporate a mass fill reinstatement and would I consider to be a total waste of taxpayers money. Sand piping via a pipeline is the only viable and cost effective option. As per my comments previously West Beach would be able to be accessed by the general public at all times rather than when trucks are not on the beach.
It would be unsightly to have cranes on the end of the jetties. The locals and visitors would be very disappointed if these were erected. Jetties & local beaches are for everyone to enjoy and share, machinery shouldn't be part of the scenery.
Apart from the obvious slurry at the end of our street I am sure there would be a lot of adverse impact from the jet pump systems on the jetties. Again...the excessive cost
Actually this is THE worst 'solution . the disruption alone ,added to the reasons given above. Does whoever suggested this actually imagine anyone could support it! Do they imagine Semaphore beach is nothing more that a quarry!
This is a completely disruptive option environmentally and socially including for locals and tourism, plus is so much more expensive than dredging and carting that it makes no sense to do this at all. It will ruin the northern beaches, be an eyesore (jetties, collection points and trucks / machinery), and there are better options available that will not be as environmentally destructive as this option will be.
Options 1.1, 1.2 and 1.3 look to be much less environmentally, socially and economically damaging overall than this option. It would be terrible to see this at the jetties and is not a wise choice given there are more sustainable alternatives on offer.
Aside from committing our beaches to the unending servicing of the pumps and pipelines, each time the slurry that emerges from the pipeline, the particle size of the tumbled sand reduces making them progressively less likely to remain where they are deposited. Not only in the construction phase, but forever after this option would be a disaster for those who love and use our beaches and for those that live near them.
Inflexible. Disruptive and high negative impact on communities beach goers residents environment. Costly. Not flexible in where sand comes from or where it is delivered. A fixed structure to deal with a moving issue. What happens to 15km of pipeline and supporting infrastructure in 20 years -

basically non biodegradable rubbish in sand dunes. Has already caused collapse of dunes in other areas
My overall preference is NOT to Dredge OR use a Pipeline - both are reactive solutions to the problem. My overall preference is to address the root cause of the issue (Climate change, Increasing Storms and Wave Movement) and create an artificial reef or breakwater ~1km offshore. Addressing the cause, not the symptoms is my strong preference.
Nevertheless, I have selected "STRONGLY DO NOT SUPPORT" as this option will close jetties for months disrupting the communities that use them. The grainsize and high carbonate composition of the sand will break down to silt and result in sand not staying on beaches but being washed into gulf waters in the form of silt plumes which could choke seagrasses. This option is unsustainable with rising sea level rises and will also result in high quantities of microplastics being washed into the sea. Once in the sea, there is no way to remove micro & nano plastics in the marine environment. Placing the sand on the beach face will cause the beach to steepen, causing more erosion. This option fails all the international metrics for successful renourishment and durability and will cause environmental harm while not fulfilling the purpose for which it is being suggested.
Although there is more sand in those locations, there is huge community opposition to taking it from thee.
Heavy machinery on jetties is unsafe and would be irresponsible and has a negative social impact to users of jetties. As a Professional Engineer who has worked in a maritime industry for more than 30 years, I know that a pipeline system would be continually breaking down and would require excessive costly maintenance throughout its life. Further, a pipeline would cause ongoing enormous disruption and safety issues to all coastal communities. I have reviewed publicly available pipeline documentation and have concluded there are numerous flaws in its entire concept, viability and ability to deliver required sand. There is no consideration of climate change impacts. I have also learned of the negative environmental impacts of a pipeline i.e. generation of tons of micro plastic particles into the sea.
Social and environmental impact of constructing pipeline and ongoing pump activity at jetty
Tractors/trucks/heavy machinery on beaches during installation, operation and maintenance of pipeline will cause maximum disruption to all communities ruining the beach amenities. Semaphore and Largs jetties are a popular tourist destination. A pump operating from a crane on the jetties will ruin the amenity for visitors and recreational fishers. This is likely to see a decline in business to those businesses who depend on visitors to Semaphore and Largs. Jetties often attract an abidance and variety of marine life. Having a dredge pump mobilise the surrounding seabed sand near the jetty would have a detrimental impact on this marine life.
The construction and installation of the 14 km pipeline will be impacted by climate change effects. Higher tides, more frequent storms and sea level rises will result in delays and cost blow outs during the construction and installation of the pipeline. The installation and delays will impact beach users, businesses and SA tourism as will the sand collection and processing activities.. The installation of the pipeline also runs right through a significant historical and cultural landscape of the Kaurna people, the traditional custodians of the Adelaide plains.

Many of Adelaide's beaches will not be free of trucks or sand collecting heavy machinery for 20 years. This will cause on going environmental damage including destruction of nesting and foraging areas of threatened species. The lowering of beaches due to sand collecting activities will put protective dunes at risk of erosion leading to possible collapse which in turn could put infrastructure & properties at risk. There will be in excess of 120 tonnes of micro and nano particles delivered to beach face and into gulf waters from the abrasion of the 14 km HDPE pipeline. There is no way to remove micro & nano plastics once in the marine environment. The sand from Largs Bay is of unsuitable grainsize and high in carbonate composition. Due to carbonate sand's tendency to readily break down the sand will be unlikely to remain on beach, especially on West Beach where the revetment wall is exacerbating erosion and there is no suppression of wave action. Sand being deposited onto beach face will steepen beach face, causing more erosion. This pipeline option is a very expensive option, leaving little or no money for any future Adelaide beach management, or money for other coastlines in SA. As we have seen from the 100,000 cubic metres of heavier quarry sand placed on in the same position on the beach face per year, 80,000 cubic metres has been washed away. (DHI 2023) Therefore this option will fail to deliver its desired outcome.This option fails all international metrics for renourishment durability and fails all ABMR goals of maximizing sand staying on beaches, avoiding environmental harm and minimizing disruption. The options with the most capital are the least flexible and flexibility is one of the key components to successfully managing Adelaide's beaches. This option has minimal flexibility. The hard infrastructure and high capital cost makes it inflexible and unsuitable as an effective option. If a cost/benefit analysis was undertaken on this very expensive, ineffectual and environmentally damaging pipeline the costs to the community and businesses, the environment and 14 km of beaches would far outweigh any benefits of the pipeline's outcomes.
This option is not considered acceptable as a result of the ongoing and significant impact the pump system would have on the jetty infrastructure and also users of the jetties. Whilst this will result in the nourishment of sand on southern beaches the impacts are not considered appropriate within the beach location.
Potential benefits
Results in appropriate sand nourishment for the southern beaches
Sand would not be taken from the beach areas in the north (only in the offshore areas) minimising disturbance to beach users
The pipeline has proven to work in the southern management areas beyond West Beach
The solution and structures are permanent
The offshore impacts are minor in comparison to dredging
Potential risks
Ongoing and frequent disturbance for beach users and residents in the northern beaches
Likely closure of the jetties from users while operations occurring
Structures located within the beach environment may result in reduction of visual amenity of not designed and located appropriately

The location of the pipeline should be appropriate so as to not cause irreversible environmental damage to the established dune system
Microplastics are a likely result of the pipeline deterioration
Risks associated with existing jetty infrastructure - pylons being undermined by the activity and or the carrying capacity of the structure
Pipeline sounds feasible and works elsewhere but is high cost
A perpetual pumping is invasive, noisy, inefficient and ineffectual.
expensive. damaging to semaphore/Largs beach. Disruptive
No to pipeline!
Many locals and visitors enjoy the peace and quiet of our jetties as they are. This will be an ugly and I assume noisy option.
Environmental damage to the dunes which will be caused by the construction
Microplastics pollution
At risk from sea level rise
Relatively inflexible
Additional permanent infrastructure along coast
Impact on access to jetties
cranes on jetties? Would the jetties even support cranes? They would be dangerous and noisy and block sections of the jetty (historic iconic jetties) from public use and enjoyment
No trucks. there is already enough sand on the northern beaches, why access the quarries its completely ridiculous
People love using the jetty the fixed jet pump I believe would cause the water to be discoloured and in-inviting
The sand required can be sourced from elsewhere.
Try Fowlers Bay.There is a jetty where a pipeline could be used to pump it onto shipping back to Adelaide.SA is a desert state,there is sand everywhere.
2.1 preferred option
Refer to comments re Option 2.1.
Obviously, cost will be an issue (also in 2.1).
Sand too fine.
Very disruptive getting infastructure in place. Previous years of trucking were bad enough, this will be worse.
We don't need more microplastics into the environment
It involves trucks and noisy sand pumps on the beach

Why? This option will close jetties for months disrupting the communities that use them. The grainsize and high carbonate composition of the sand will break down to silt and result in sand not staying on beaches but being washed into gulf waters in the form of silt plumes which could choke seagrasses. This option is unsustainable with rising sea level rises and will also result in high quantities of microplastics being washed into the sea. Once in the sea, there is no way to remove micro & nano plastics in the marine environment. Placing the sand on the beach face will cause the beach to steepen, causing more erosion. This option fails all the international metrics for successful renourishment and durability and will cause environmental harm while not fulfilling the purpose for which it is being suggested.
Jetties are a treasured feature of the SA coast line and having them used as a basis for heavy machinery is a highly undesirable option.
Do not support as there is no meaningful modelling. Also it is an eyesore.
Looks like a massive intrusion on our jetties.
Eminently sensible
Beach sand needs to be managed. I am happy for the experts to determine the best way.
Unlikely to gain adequate social licence. Facts aside, jetties are strong foci of recreational activities, and much public education would be required before the option became viable politically.
Dredging is detrimental for marine life
You have got to be kidding. Put a dredge on a jetty. Sure that will work. You want the pipeline to fail....
We can see the destruction at Semaphore beaches due to this practice and environmental advice is that an increase in big storms will further increase erosion. removal of sand from near or on the beach increases the risk
See comments above for against pipeline. Our jetties are used all year round and this would greatly impact on those people.
Too permanent can rotate where taking sand from
Are you kidding me? This is environmental terrorism. the jetties are a source of pleasure and relaxation and have been shown to promote stronger mental health and you want to industrialise them. Such madness.
The jetties would be obstructed by the pumps and noisy
This will destroy beach visitation, local businesses, the community will be unhappy, and it will destroy the northern beaches. A pipeline is too damaging for the coast, too expensive, and is not flexible - it is better to go with dredging which can be changed within a few years if actually needed, rather than locking in a 20-year expensive and damaging pipeline project.
If as you say we have large deposits offshore, then why inconvenience the public.
Our jetties are a tourist draw cards all year round.
Ugly, disruptive and noisy for those of us who use the beach most.

No idea of approvals
Seems unnecessarily complicated
At least u have usable recycled sand
Absolutely not. Pipes constructed from plastic which disintegrates rapidly leaving micro plastics in the gulf forever
Same as 1.3
Impact on availability of jetties for public use
Are you kidding?
Will impact on use of jetties and sand dredged will not likely remain long on beaches. Very expensive.
Not suitable option
Jetties become unusable.
Trucks on beaches make them unvisitable.
Noise.
Pipeline pumps out nanoplastics into the sea.
Pipeline damages the environment,
Also, where would the trucks be kept at night? They're usually left near the work site. Another eyesore in front of people's houses. Tourists and beach visitors will keep away. That would be so bad for local businesses.
Why choose such an invasive option, when better options are available?
The collection of sand from Jetties will have a detrimental impact on the public's ability to enjoy the jetties for some months of the year.. The construction of the pipeline and its associated infrastructure will be highly disruptive to all communities along its path. Micro-plastics will be deposited into the ocean and beach areas. Cost is the biggest and therefore less flexible. Pump stations and cooling towers will impact local residents and visitors to the area. Trucking sand has again all the environmental problems associated with trucks on roads.
• Desk top review and no modeling
• Visually unappealing and could result in infrastructure damage.
I can't see any way a pipeline installation wouldn't cause irreversible environmental harm to the beach or dunes
The sand is too fine, it is a major disruption to Northern beaches, there are major negative environmental impacts. There is not one positive thing about the pipeline apart from taking trucks off of West Beach! West Beach is not a major attraction point, with no jetty, main strip, or community grassed areas - unlike Semaphore beach. Semaphore is a major/popular beach, attraction, and meeting location for many families and communities of the Western and Northern suburbs. Semaphore holds decades of history and is well loved by many in Adelaide. Having trucks, sand

carting, or a jetty closed will stop many from continuing with their daily recreational and calming activities like walking, fishing, meditating, running, bike riding, and so many more. I don't understand why you would want to ruin a very popular, major beach to save a beach with no major history, recreational activities, or popularity to SA. I urge you to perform a survey of those that attend Semaphore vs West Beach throughout the year... this may cause you to rethink this decision.
1. Any sand taken from Semaphore, Largs and Taperoo beaches is not being 'replaced' at a reasonable rate. There does not seem to have been any consideration of replacing sand on these beaches when they have been ruined.
2. Pipeline infrastructure is large, noisy and makes sections of the beaches permanently unusable. This is unfair to beach users, and is not a solution which considers the longer term.
3. Pipelines required trucks on the beaches permanently. This is unacceptable.
Environmental and amenity disruption, how will this affect recreation fishing, seal and dolphin populations?
Pumping sand is costly to the environment
I don't understand why you would ruin beach and jetty use when an offshore dredge is an option?
No!
The cost and the disruption to the beach far outweighs the benefits of this option
An absolute eyesore for residents and visitors. Disruptive to community, lifestyle and wildlife.
Costly infrastructure required which will damage historic wooden jetties and northern beaches and dune systems, Inflexible to adapt to rising sea levels.
Produces unacceptable, large volumes of abraded plastic pipeline microplastics to the marine environment over its life time.
I cannot believe this is an option! See my previous statement about pipelines - plus have our jettties [noisily] blocked off several months at a time? Goodbye, peace and quiet, and recreation for locals and tourists.
This is also nearly as awful as 2.1 due to loss of amenity of the jetties for residents and beach users, would the jetties be damaged by this kind of usage for which they were not designed, and loss of sand around the jetties leading to further damage and loss of saline
See comments Option 2.1
As per answer 15. As well as those objections this option would also risk collapsing of the jetty.
'Vacuuming' seabed sand in the vicinity of one or more jetties does not seem good environment practice when seabed ecology has already suffered a great deal in recent decades. Jet pumps on a jetty will inhibit public access and be noisy, and may well place stress on the jetty's structural components. Construction of a pipeline will entail significant damage to the dune system, and the life it sustains, for the many kilometres from the northern beaches to West Beach. This option 2.2 is now seen to be very expensive compared with the environmentally less damaging options involving dredging or dredging plus use of quarry sand. As noted earlier, I do not support any option involving

a sand pipeline because of destruction of dunes, disruption to community enjoyment and the resulting negative effect on the income of the many local businesses which rely a great deal on visitors to the beach.
Pipeline
1. HARMFUL AND DEVASTING LONGTERM IMPACTS TO OUR COMMUNITY. THREATENS THE FOLLOWING -
a) Loss of tourism, loss of community space, loss of community well-being due to invasive and destructive annual practice of quarrying sand from beach or near shore areas.
b) Negative Impact to local businesses of Semaphore and Largs Bay during winter when business is marginal at best (i.e., role of beach, dunes and foreshore in visitor economy and supporting local business activity)
c) Damages the role of the Northern coasts in identity of place (i.e., activation of beach and community activities in dunes and foreshore)
d) Loss of Public safety (i.e., truck movements on beaches at 40kph equal to Semaphore Road, excavations on beach and intertidal zone);
e) Loss of Public amenity (i.e., noise, truck speed, beach closures and nuisance impacts);
f) Detrimental to Natural environment and increase in coastal erosion (the removal of sand from the beach and tide zone creates a relative sea level rise by localized lowering of beach, storm surges then destroy dunes because the ocean can reach them).
g) Accelerates threats to local infrastructure by destroying our first line of defence from storm surges – beach and dunes
h) Loss of beach/jetties access for sports, leisure, and mental health
i) Accelerated coastline loss, dune recession and destruction
j) Impacts to flora and fauna (environment)
k) Increased Noise and air pollution from trucks, pumps, excavators
l) Works against nature, invasive, destructive
m) Impacts to local recreational fisherman and crabbers when considering extracting from around jetties or between jetties.
n) Pollution and health risks from nano plastics created from transporting a quartz slurry thru a PVC pipeline
o) High capital costs that impact community as taxpayers
p) Not flexible meaning the damage will be unsustainable and ongoing until project failure/termination/abandonment. Internal sand has proven ineffective in maintaining and sustaining West Beach. nd there is no modern evidence that Northern beaches are receiving sand from West Beach, in fact the coastline is now eroding.
This will wreck the beach AND the jetties. Pipeline is too costly.

I don't support the Pipeline options because of the significant environmental impact that this permanent structure will have when being build in the dunes or along the beach but also when it will be used with all the detrimental effect of micro plastic for example and not to forget what we would also legate to the next generation when this infrastructure will arrive to its end of life.
This is also a very expensive option with a number of technical downsides (transport of fine sand that don't stay on the beach, limited sources of sand where it will be taken on the Northern beaches while this sand is needed to protect the coast there against the increased storm pressure).
Likely to be aesthetically unappealing and may exhaust local seabed reserves.
Costly ongoing short term solution
Dredging is not ok
Seabed ecology is already suffering.
Jet pumps are noisy and place stress on the jetty.
A pipeline will cause significant damage to dunes and the life within.
Very expensive compared to environmentally less damaging options.
I do not in any way support a destructive sand pipeline.
A pipeline is NOT a solution. Plastic pipe = micro plastics straight into beach, environmental impact, trucks on the beach, maintenance costs to taxpayers, LOSS OF SAND FROM LARGS!! Plus would require closing off the jetties for periods of the year - this would have costs to tourism and recreational uses by local residents.
Pipeline will close beach for construction and make it noisy when operating
See my previous comments regarding the damage dredging causes.
What about the Sealife?
Impacts jetty amenity, pipeline is expensive and will damage the beach environment across entire Adelaide metro coastline. Delivery of sand directly onto beach is less effective than near shore deposit utilising natural wave motion.
See previous answer
Same reasons as above plus more - not only will our beaches be unusable and destroyed, the jetties will be unusable for months as well. It will cause environmental disasters. This option fails fails fails.
Ongoing and frequent disturbance for beach users and residents in the northern
beaches
Likely closure of the je es from users while opera ons occurring
Structures located within the beach environment may result in reduc on of visual
amenity of not designed and located appropriately
The loca on of the pipeline should be appropriate so as to not cause irreversible
environmental damage to the established dune system

Microplas cs are a likely result of the pipeline deteriora on
Risks associated with exis ng je y infrastructure - pylons being undermined by the
acivity and or the carrying capacity of the structure
- How is this an option to close popular jetties for periods of time every year
- I walk on the sempahore jetty 5 mornings a week and most of the mornings there are people fishing of the jetty and EVERY day people walking on the jetty
- The Sempahore shelter would have to be removed - so many people sit under the shelter every day of the year to de-stress
- The environmental damage of building the pipeline would be irreversible - impact to sand dunes and local coastline
- Information from Digital Earth Australia (DEA) shows Semaphore and Largs have actually LOST sand since 1988, furthermore the sand is fine and does not stay on West Beach
- DOES not take trucks of beaches
- 3-4 months of the year the beach would be subject to trucks and heavy machniery on beaches - who would make a decision to do this on popular beaches that are used ALL year round (Semaphore and Largs), how can this be considered an equitable solution
- The pumping stations would be noisy, ugly and impact local residents and businesses
- Long distance to pump sand, the cost of running let alone the environmnental impact of running and maintaining would be totally ridiculous
- Has the impact of the plastic deposits from the pipeline into the ocean been considered and what this would do to our ocean species
- Pipeline is the MOST EXPENSIVE option by far
- Maintaining the pipeline and pumping sand would be a huge cost and massive impact to the local community and South Australians that frequent the beaches where the sand is being 'harvested'
- Pipeline DOES NOT FIX the problem for beaches loosing sand it is just a solution to Rob 'Peter' to pay 'Paul' at a significant environment and community cost
- Nothing positive about the pipeline solution
Pipeline
1. HARMFUL AND DEVASTING LONGTERM IMPACTS TO OUR COMMUNITY. THREATENS THE FOLLOWING -
a) Loss of tourism, loss of community space, loss of community well-being due to invasive and destructive annual practice of quarrying sand from beach or near shore areas.
b) Negative Impact to local businesses of Semaphore and Largs Bay during winter when business is marginal at best (i.e., role of beach, dunes and foreshore in visitor economy and supporting local business activity)

c) Damages the role of the Northern coasts in identity of place (i.e., activation of beach and community activities in dunes and foreshore)
d) Loss of Public safety (i.e., truck movements on beaches at 40kph equal to Semaphore Road, excavations on beach and intertidal zone);
e) Loss of Public amenity (i.e., noise, truck speed, beach closures, jetty closures, and nuisance impacts);
f) Detrimental to Natural environment and increase in coastal erosion (the removal of sand from the beach and tide zone creates a relative sea level rise by localized lowering of beach, storm surges then destroy dunes because the ocean can reach them).
g) Accelerates threats to local infrastructure by destroying our first line of defence from storm surges – beach and dunes
h) Loss of beach/jetties access for sports, leisure, and mental health
i) Accelerated coastline loss, dune recession and destruction
j) Impacts to flora and fauna (environment)
k) Increased Noise and air pollution from trucks, pumps, excavators
l) Works against nature, invasive, destructive
m) Impacts to local recreational fisherman and crabbers when considering extracting from around jetties or between jetties.
n) Pollution and health risks from nano plastics created from transporting a quartz slurry thru a PVC pipeline
o) High capital costs that impact community as taxpayers
p) Not flexible meaning the damage will be unsustainable and ongoing until project failure/termination/abandonment. Internal sand has proven ineffective in maintaining and sustaining West Beach. We must seek external sand to maintain beach position.
How is this an option to close popular jetties for periods of time every year
- The Sempahore shelter would have to be removed - so many people sit under the shelter every day of the year to de-stress
- The environmental damage of building the pipeline would be irreversible - impact to sand dunes and local coastline
- DOES not take trucks of beaches
- 3-4 months of the year the beach would be subject to trucks and heavy machniery on beaches - who would make a decision to do this on popular beaches that are used ALL year round (Semaphore and Largs), how can this be considered an equitable solution
- The pumping stations would be noisy, ugly and impact local residents
- Long distance to pump sand, the cost of running let alone the environmnental impact of running and maintaining would be totally ridiculous

- Has the impact of the plastic deposits from the pipeline into the ocean been considered and what this would do to our ocean species
- Pipeline is the MOST EXPENSIVE option by far
- Maintaining the pipeline and pumping sand would be a huge cost and massive impact to the local community and South Australians that frequent the beaches where the sand is being 'harvested'
- Pipeline DOES NOT FIX the problem for beaches loosing sand it is just a solution to Rob 'Peter' to pay 'Paul' at a significant environment and community cost
- Nothing positive about the pipeline solution
As per Option 2.1
No trucks or use of jetties which would ruin the beaches and access to them by the public. It would decimate the beaches as the trucking has already left an imprint.
Community disruptions to jetty use & again sand source issues
Social, noise, safety, level of disruption and cost. Disruptive infrastructure on jetties, collection stations and trucks on beaches. Jetties are used by tourists to view the bay/landscape - fixed jet-pump system would be a huge deterent. Also, those with walkers or wheelchairs who often do visit the jetties would not be able to do so without noise/social disruption.
This option will close jetties for months disrupting the communities that use them. The grainsize and high carbonate composition of the sand will break down to silt and result in sand not staying on beaches but being washed into gulf waters in the form of silt plumes which could choke seagrasses. This option is unsustainable with rising sea level rises and will also result in high quantities of microplastics being washed into the sea. Once in the sea, there is no way to remove micro & nano plastics in the marine environment. Placing the sand on the beach face will cause the beach to steepen, causing more erosion. This option fails all the international metrics for successful renourishment and durability and will cause environmental harm while not fulfilling the purpose for which it is being suggested.
Do not ruin the jetty or close access it
Effects of dredging on seabed flora and fauna, eg turbidity
By creating permanent pipeline infrastructure protects our beaches from future de-funding
Stealing sand from Semaphore/Largs Bay on an industrial scale to shore up West Beach would be pandering to those operating nearby businesses such as the caravan park and the surf club.
permanent infrastructure needs to be developed to protect the beach management from future de-funding
I find this an absurd concept
Use of jetties and storms at time of dredging is ridiculous
Seems like an appeasement to avoid scrapers at times of collection.
Easier to collect at levels of low tide and arguably now in the north during high tide

Similar to 2.1, however jetties will be closed at the source of the sand. Do not support closure of recreational jetties for 4 months for the next 25 years.
These jetties are in the centre of the recreational areas. Hotels and event venues face these jetties. They are hubs of activity. This will be disruptive to the communities
Whilst cranes and jet jet pumps and fixed jetty pumps have worked elsewhere, such as at the Gold Coast and Delaware in the USA, these systems are far from homes and businesses.
There will still be pipelines and and pump stations-so not supported for the same reasons as mentioned in 2.1
Also there will carting of sand to West Beach for 5 years, because there is insufficient sand at Largs and Semaphore-which is disruptive. This is also true for option 2.1
damage to shoreline
The impact on the jetties, and on the surrounding seabed from which they are taking the sand are my two main concerns.
Again this is a broad option and not well defined.
Sand from off shore dredging, No I don't support.
Sand from inshore dredging No I do not support.
Trucked in sand, no I don't support.
Too many variables in this option to support.
Because of information I have read from Save Our Shores (SOS)
Cranes on jetties -terrible idea. Terrible to see what's happening at Glenelg with noise and equipment and trucks and beach fenced off for many months of the year. It seems to be getting longer each year. Also theres other very ugly bulky equipment near the playground. Not a good idea for Semaphore-bad enough at Glenelg
This option cannot go ahead. It is extremely damaging to the dunes, is not a long term option and will create destruction during its installation, operation and removal. This option has received continued angst for good reason and the community must be listened to. You cannot put something of such hard infrastructure through what are extremely weak and fragile dunes home to endangered species and plants. This option also does not take trucks off the beach. In conversations with residents around the existing pipeline have expressed their disgust regarding noise and visual pollution and overall dissatisfaction from the pipeline. Do not allow this option to happen. Listen to the community, please. This option is not fair on Semaphore and Largs residents. Residents and visitors at these beaches should not have to suffer additional noise, visual and physical pollution in the sake of other beaches. It will cause division and add to existing tension. This solution will not be supported by the community as has been expressed for years.
Very disruptive to beach visitors.
Unsightly and noisy.
Can lead to dangerous erosion of beaches near the jetties.

Will destroy northern beaches to repair others.
I do support using trucks to distribute quarry sand.
I support the pipeline component. I don't support dredging the marine floor and the social impacts of having to close the jetty for several months of the year annually.
Pipeline is going to damage dunes. Too expensive. Water waste. Heavy machines on the beach. Lots of trucks. Short lifespan. Northern beaches are eroding already without harvesting and pumping sand. Jetties are for the community to enjoy
I do not support the pipeline option especially this one that restricts access to both beaches and jetties
Noise and machinery
Definitely not. This is worst of the worst. Our Beaches are a draw point for tourist families and everyone else,even the family pets. We want all our beache be pristine, not just 1. I am furious this is even an option. Devastation after Devastation erecting this option. Get rid of it, NOW and never have it suggested again.
Destruction of the underwater area around the jetty

Please explain your level of support for Option 2.3 - Pipeline using a temporary dredge

This option has on-going emissions production from a boat and truck powered by fossil fuel. A fix needs to be i place that has little or any on-going work or labour requirement. Also visual and noise impacts.
unsure
In light of the additional costs and the substantial environmental and infrastructure damage during installation any sand pumping option makes no sense. Unlike the dredging only options this also introduces beach user inconvenience albeit less than the beach harvesting options.
This makes better sense than 2.2
BUT it will have a significant effect on access and use of beaches. Which will be its demise
Waste of resources.
on data presented :
- very high cost (Estimates are selection phase so little engineering completed to get to better than +/- 50%
- large amount of infrastructure required
- impact on local residences and beach goers
- large environmental and social impact

Support what ever is required to maintain a usable beach.
Cost & practicality
Actual costs will be significantly more than the estimate and does not fix the sand build up on beaches at Semaphore
A pipeline and trucks would make the beach less attractive/relaxing. They may also impact access to the beach.
This option represents the worst features of two bad options. Dredging is destructive of the coastal environment, as is a pipeline. This review is supposed to be directed at options that better manage the suburban coastline, not inflict further damage on it.
Semaphore and Largs Bay beaches are receding due to mining, rising sea levels, subsidence and increasing frequency of storm events. Taking additional sand from the near shore would be reckless.
Better than the jetty option, but still not the best option
Seems a bit complicated, but still a pipe is better than anything else
Less disruption in collecting sand, seeming limited benefit compared to directly releasing sand from dredge per options (1.X). High cost.
Question is always "At what level of expense will we go to to keep replacing sand before we acknowledge that sea level rise is going to win?
Price and don't think we need to build pipeline infrastructure
Taking the sand from off shore removes some trucks from the beach and as long as there are dredges available it is one of my preferred options.
This might be a good option compared to the others and it could be less destructive than other proposals.
Support pipeline but not trucking
Irresponsible, carbon intensive , ineffective
seems to be combination of all solutions and would be expensive
Not sustainable long term
See comment above NO TRUCKS!
Novtrucks
Quarry sand does not belong on beaches. Dredges will degrade the ocean bed and disturb plants and animals that live there. The environmental effects need to be considered ahead of people's desire to have sandy beaches.
Much better solutions available. This is an embarrassing environmental message to the world.
Too expensive
No pipeline!
As above

The energy sources must be 100% renewable. No use of fossil fuels.
Cost and noise. Just not an intelligent solution.
intrusive
As above, trucking is intrusive to beach users and degrades the beach surface
I do not support a pipeline in any way.
May be possible using sources near north haven and outer harbour breakwaters
Trucks on the beach at West Beach are only good for the sand carting company dollars.
Most inconvenient to beach goers and the Plovers that are supposed to be protected
Environmental damage. Quarry sand is not beach sand
I think it would provide sand with the more disruption to the beach goers, but the damage it will cause to the sea bed and the surrounding marine life will be less
No dredging near the shore. Dredging impacts marine organisms negatively through entrainment, habitat degradation, noise, remobilization of contaminants, sedimentation, and increases in suspended sediment concentrations.
Quarry sand component is not sustainable and cost effective
Whatever is the most effective for the largest volume and suits the prevailing circumstances.
It involves trucks on the beach for collection. No.
as per jet pumps proposal... expensive tinkering!
No evidence of sustainability / concern of available resources over decades to maintain this work / impact on environment
Do not support the use of Quarry Sand
There was not sufficient information in the discussion paper to make informed input. There was no assessment of environmental impact of options or carbon emissions impact. There was no long term system change options presented. There was no explaination of why other options were not assessed. The options represent status quo and are not suitable options.
Large trucks on the beach are dangerous. I do not support mining dunes for sand
need more details. If a dredge is used there is no reason to have a pipeline. Please study the Maroochydore dredge report.
I can't strongly support this as I would need more information. But again it seems like more added pressure on the environment.
Just shifting the problems
Waste of money
Too much disruption
Jetty damage unacceptable

Damages the beach
You will wreak the source beaches to try and 'fix' another beach. Hugely disruptive to the source beach. There's still damage to the beaches of Largs North and Bay from earlier work.
Not sure, needs to be more info than a short question like that.
This option would be cost dependent on the trucking of sand from quarries
1) cost
2) disruption
3) use of trucks
Same as above .
Again jobs
An acceptable option but prefer hard infrastructure in place.
I support the pumping as long as it is only targeting the excess drift sand and not damaging established sea beds
Environmentally devastating for northern beaches!!!
Significant Environmental concern for local northern beaches
This option has not worked anywhere else. Causes the most harm and disturbances to beach goers and nearby residents.
Not in favour of pipelines
Looks like good combination
Any pipeline option is:-
* very expensive and once the money is spent other options will be resisted by future governments.
* Northern beaches dont have 'spare' sand. Their dunes are eroding NOW as sea level rises and storms are more frequent.
* Northern beaches will need new sand within a few years to prevent erosion back to infrastructure. Once foredunes are breached storms will reach roads, carparks, homes.
* Pipeline input points are noisy and disruptive for people and animals.
* Due to cost, a pipeline will making obtaining sand from sources such as York or Eyre peninsular or Murray Mouth too expensive. Given pipeline costs (plus running costs and environment costs) other sand options should be considered if government wont buy its own quarry.
On shore pipeline doesn't work, which has been proven already.
Still disturbing sea life
As above
Good option to harvest sand offshore but utilise a more efficient transfer of sand
Dredge from port stanvac end and dredge as far offshore as possible

More garbage.
All the same reasons as the last two questions. A pipeline is an environmental, unsustainable and horrendously expensive disaster
I totally disagree with a pipeline and sand collection stations. The impact this would have on all part of the beaches including the environment, dunes, marine life and the flora and fauna.
The cost to do this is outrageously expensive considering there is better options with less impact.
https://climate-adapt.eea.europa.eu/en/metadata/adaptation-options/groynes-breakwaters-and-artificial-reefs
Adelaide shores should never have been built
This option seems to have the worst of all options: high cost, disruption & enviro consequewnces of trucking sand, - & cost + visual impact of pipelines.
Short term solution only with disruption to beach users.
Lesser of 7 evils
Concerns about safety of trucks around kids in beach. It's hard to handle already when the trucks have been there. Also when sand is piled onto the beach sometimes there are voids underneath that some people can fall into- already seen them myself - and it's pretty impossible to keep kids and dogs off the piles or hills
2.1
Offshore is good but loose the trucks
Damage to en vironment
Depends on environmental impact
We do not want a pipeline.
No pipeline
As above no machines on beach, cheaper and less intrusive and works well In qld
High impact on beach users
Disruption by trucks eliminated at points of source and delivery.
The volume of sand sourced near shore Largs Bay, location of sand, quality of sand untested. EPA approval unlikely, untested. EIS approval unlikely, untested. Total dredging 'nonsense' as a genuine option. Therefore dredging is greatly improbable.
Delivery by pipeline of sand is ACCEPTABLE, -pipeline strongly supported but collection is nonsense.
Sand ultimately placed at West Beach in the dry zone and not tidal area, or -2m AHD, ensuring community benefit prior to entering into littoral drift.
Expensive and makes no sense.
This seems to be a flexible option but messy to coordinate.
Stupidly expensive with no benefits over option 1.

Again dredinging the nearby seabed sand cause issues with Marine life, also the void created would be filled by surround sand so no real benefit
See earlier comments
Impacts beach environment and restricts pedestrian access to beach.The creation of the pipeline and its ongoing use will impact residents. Appears to be a very expensive option.
ABSOLUTELY NO TO A PIPELINE: ENVIRONMENTALLY DESTRUCTIVE AND A METHOD THAT WILL SIMPLY NEED REPEATING ENDLESSLY AND NEEDLESSLY.
THE POTENTIAL LONGER-TERM TO PERMANENT SOLUTIONs OF THINGS LIKE REGROWING OUR SEAGRASS BEDS - LONG SINCE DESTROYED (I HAVE BEEN LED TO BELIEVE) BY OUR OWN HUMAN FAECES - ARE SURELY WORTH A TRY, RATHER THAN THE KNEE-JERK AND BANDAID SOLUTIONS PROPOSED.
Better than a pipeline, but trucks are still annoying for everyone on the beach.
Appears inferior to dredging only, given the reasons previously articulated. Again it appears to be an unnecessary hybrid. If dredging only were used, this is perhaps the best of option 2 variants, but again I don't see it as superior to dredging from the information provided.
Terrible option - pollution, disruption, terrible use of resources. STRONGLY OPPOSE!
There will be sea grass and ecological damage to the environment due to this practice. Will sand carting provide dense sand.
Negative impact on the ecosystems and sea life
Damage to near-shore seabed. Noisy pumps running all day diesel engines high CO2
ditch pipeline idea, stupid. Especially when only temporary, all that construction and damage for what . improve wildlife and animals that have shells, minimise people if needed and actually make a difference that will change things.
Pipelines work
Same as above
Cost of this solution and impact on Seagrass close to shore and effect on marine life!
No trucks, no quarry sand. Use natural offshore sand bank deposits
Siltation and damage to seagrass a certainty.
Again its the same issue as before the beaches will be decimated.
Too intrusive
Too much sand at Largs North
Want to leave the seabed as untouched as possible.
Increased heavy traffic along beach roads will damage local roads
And again - This option does not meet any of the three requirements of the solution. It causes horrendous disruption for Semaphore/Largs communities and all of the many thousands of

Adelaidians that use these beaches. Clearly the trucks are not removed from the beaches and roads and heavy machinery present on two of the states most popular beaches would be astoundingly backward. There is massive amounts of erosion along these beaches and the latest DEA data proves these beaches are shrinking and cannot be used as a sand mine for West Beach. The sand mined is fine and does not stay on the beaches and it is massively expensive. It amazes me that the pipeline solution is still even discussed it's that much of a discredited solution.
Trucks are dangerous on the beach. Piping creates ugly, polluting and unnecessary infrastructure. Destruction of habitat inevitable in establishment of pipeline
This just complicates collection and depositing of sand. Need a simple streamlined approach that for the best part of the year removed the need for trucks on beaches.
Polluting, expensive and illgogical
Ditto to previous questions, I absolutely do not support the construction of a pipeline or associated infracture
This options still requires trucks on beaches that destroy the shoreline and obstruct use of the beach to the general public. for large amounts of time. The dredging is also too close to the shoreline, could cause deep ravines that become dangerous for beach goers. It requires a lot of unsightly machine obstructing use of what is the most popular beach in summer.
Good idea
Not convinced about the potential damage of sea floor due to dredging.
As above: TRUCKS are environmentally and socially unacceptable
As above: plenty of sand available ON THE BEACHES at Largs and Semaphore
Short term solution only
Can't see dredging is feasible and can't get in and fix storm damage which occurs quickly and still needs a mass fill, don't know where the source of sand is for dredging.
Environmental concerns
Strip the dredging
Could equlise sand for all beaches
See above - any other major city in australia would do everything they could to preserve such a beautiful environment so close to urban environment and sell it to the world. look at the Sydney foreshore projects. I can see why the rest of australia views us as backward
Quarry sand on beaches is a very silly idea. Beach sand has its own ecosystem of micro-organisms which is disrupted by human usage. Vehicular traffic compresses the sand and kills the organisms. Quarry sand has a completely different environment and the two will not mix well.
Wiuld be concerned as to how much sand can be dredged & what the impact on seagrass beds & sealife would be ?
$$

see previous
pipeline is good--but dont want trucks disrupting beach goers and local residents
See response for 2.1
I oppose the collection of sand from Semaphore region as, even though in your info material it states otherwise - there is a very REAL problem of erosion at Semaphore beach. It's clearly eroding and getting worse when its being taken from Semaphore South, the sand is not able to build up at Semaphore beach itself. Also, where does this equipment traverse the neighbourhood? Again - heavy sand cart trucks and equipment goes along Bower rd - my street - and rattles my house.
Social impact, noise, safety, level of disruption and cost with infrastructure on jetties, collection stations and trucks on beaches
stupid
Best solution for all beaches - replaces beach sand at West Beach without trucks at northern beaches- which have too much sand already - you cannot walk under Granfe jetty all the way
Less than ideal solution. Pipeline far more efficient than trucking
Should have been done before
Dredging from the seabed is an environmental issue.
As above.
Do not support dredging and damage to sea bed and sea grasses.
Still left with pump stations and pipeline creating the semi-industrial use of the beach and dune systems. The community in Semaphore /Largs has already demonstrated there is no social licence for this type of solution.
See previous comments.
The use of a fixed onshore pipeline to transport dredged sand will be the most expensive and least flexible option canvassed.
Do not support the use of any heavy vehicles on beaches for environmental, safety or financial reasons
A very expensive option and I don't think the sand should be taken from the seabed near the shore.
grain size and composition unsuitable as feed for a pipeline as significant carbonate component will break down into silt, Unsustainable with rising sea levels, pipeline produces significant volume of micro plastics, delivers sand only onto the beach which is only a cosmetic effect and very temporary failing all international metrics for renourishment durability. Expensive.
As above same concerns disturbing seabed and don’t want trucks on beaches
NO to the pipeline, full stop.
See comment to 17
Trucks on beach

No pipeline wanted
destroy sea floor
Pipeline is the least intrusive way to move the sand. In the same way that it is done in Seacliff/Brighton
Dredging sand is NOT an option due to destroying (smothering and choking) reef and seagrass habitat. Dirty water blocks sunlight and so kills seagrass. Thick silt cover kills healthy reef habitat.
We have already lost 80% of seagrass along metro Adelaide. Dredging would reverse the increase in reef and seagrass health
Seed for Snapper project - fishers
Waste water - Bolivar
Greenfeilds wetlands /recycles water
Shell reefs
Option 2.1 Pipeline (supplemented with carting sand from Semaphore) will effectively manage sand on Adelaide's beaches in a way that minimises disruption for communities, avoids environmental harm, and maximises sand staying on beaches.
If we are moving sand for our own enjoyment of beaches and protection of our homes and infrastructure then we need to accept disruption to our lives - not expect marine life to suffer as a result of our needs and wants.
External sources of sand, quarries - where are they located? Where are future sand quarries located?
Strongly reject all pipeline projects. Costs are prohibitive.
I want trucks off beaches
Same as 2.1 and 2.2
All options do not give sufficient attention to the environmental and micro-organism/micro-crustacean impacts of moving sand or adding quarry sand - i.e. actual and potential environmental impacts. The pipeline appears to work well at Seacliff but are we sure it isn't creating problems for the natural marine life balance elsewhere?
Expense and emissions.
What effect does our have on marine environment?
This option is not cost effective and requires heavy machinery to operate on suburban beaches, presenting a risk to beach visitors.
Disruption to beach users & unsightly infrastructure.
Again what are the environmental impacts? I support the option with the least negative impacts
Need specifics on how far out the dredge is, how detriment to seagrass and marine environment will be avoided. Heavy vehicle traffic on the beach negatively impacts and increases erosion activity.

I do not want to see anything near the shoreline or have collection stations at semaphore & Largs beaches.
There would be a massive impact on and degradation of the beaches from which the sand is sourced.
There would be a huge negative impact on visitors and residents of the beaches from where the sand is extracted. The abrasion of sand inside a plastic pipeline would eject nano plastics into the marine environment. All the beaches between the collection point and deposition point would be excavated for said pipeline which is an abhorrent notion. The compaction of our beaches by heavy vehicles will also be disastrous for the beach ecology inc disruption to bird life, macro invertebrates, disturb the natural hydrology of the beach and contribute to increased frequency of localised higher tides. The sand in situ at proposed collection points is a natural line of coastal protection to assets owned and utilised by visitors and residents. We cannot afford to reduce our beaches in view of climate change and the increased frequency in king tides and storm activity. Beaches MUST be protected.
The review does not consider the effect of dredging on the offshore environment
Unable to comment as it is not clear where the sand will be collected from. Would provide more support for this option if it was collected from significant deposits (away from depleted areas)
Expensive and what happens after the temporary dredge do not trust future decisions
feasibility needs to be proven steady state, also how would short term eg storm damage fills be managed? Where would the sand be dredged from?.
See previous comments. The use of a fixed onshore pipeline to transport dredged sand will be the most expensive and least flexible option canvassed.
Returning the sand from West Beach to West Beach seems like the only way to maintain equilibrium. I know that long-shore drift is a thing, however, as a community we have built on the sandhills (at WB and generally) and if those sandhills erode, a lot of the city will be underwater.
I don't really understand where, exaactly, the sand is collected here. Or the risks.
However, as long as sand comes back to WB, from northern beaches, I am happy.
As per other comments already made in options I do not support
Again I have serious concerns about dredging options.
Collection from the near shore by mobile dredging is disruptive to beach users and not desired. The mobile unit would mean that location of dredging becomes uncertain and difficult for beach-users to predict and plan.
Seems overly complicated
as above
Interfering with the environment will be a never ending waste of time, resources and money, which can be better directed by the Government into more productive areas such as Hospitals, Roads and Schools.

Damage that would be caused to the marine habitat
- Pumping stations will be disruptive to communities and environmentally damaging
- Will cost more than double compared to the dredging options
- Will negatively impact businesses and tourism for many beaches
- The 15km pipeline will be embedded through fragile dune and beach ecosystems
- Will cause massive disruption to communities during installation, operation and maintenance
- Will deliver at least 135 cubic metres of nano and microplastic particles onto our beaches and into our gulf waters
- It will lower beaches which are being mined of sand which will put their protective dunes at risk
- Sand grain size at Largs Bay is not large enough to remain on west Beach once it has been deposited.
- It has been wrongly assumed by DEW in the past that sand has been building up at Semaphore and Largs Bay beaches and that mining from these beaches is sustainable into the future. 2022 DEA CSIRO satellite imagery shows this not to be the case and over the last 30 years 30m of beach has been lost from Largs Bay and 70m of beach has been lost from Semaphore.
- Sand which has been carted to West Beach prior to 2023 has not remained on the beach, so a pipeline delivering sand there will have the same result.
It may be ok short term
This is probably the best answer from all previous options. The dredging sites would need to be surveyed by marine scientists before getting a green light.
Dredging will heavily impact the seagrasses and produce turbidity. Again, I believe there would be issues raised in the environmental impact study
Least disruption
I don't understand why dredge pump needs to be completed by land-based quarry material. Volume? Quality? either way, the trucking element puts me off. High cost, environmentally unsound.
Same as above
Temporary Dredging with a pipeline at least means the damage will be found out before anything permanent - expensive, but better than permanent damage by other dredging options.
Costly infrastructure, inflexible to adapt to rising sea levels, most negative impact on northern coastal communities. Current nourishment onto beach proven to NOT meet international durabiliity metrics. Produces large ampounts of nano-plastics which will be harmful to marine environment. Most costly with marginal to nil benefit.
SEE ABOVE. Pipelines are NOT supported in any form for environmental and beach safely reasons.
Negative impact to beach users
- Pumping stations will be disruptive to communities and environmentally damaging

- Will cost more than double compared to the dredging options
- Will negatively impact businesses and tourism for many beaches
- The 15km pipeline will be embedded through fragile dune and beach ecosystems
- Will cause massive disruption to communities during installation, operation and maintenance
- Will deliver at least 135 cubic metres of nano and microplastic particles onto our beaches and into our gulf waters
- It will lower beaches which are being mined of sand which will put their protective dunes at risk
- Sand grain size at Largs Bay is not large enough to remain on west Beach once it has been deposited.
- The littoral drift of sand from south to north has not resulted in a build up of sand on Henley North, Semaphore and Largs Bay beaches. 2022 DEA CSIRO satellite imagery shows that over the last 30 years, 30m of beach has been lost from Largs Bay and 70m of beach has been lost from Semaphore. These beaches cannot be used as sand mines; it is destructive and clearly not sustainable.
- Sand which has been carted to West Beach prior to 2023 has not remained on the beach, so a pipeline delivering sand there will have the same result.
It would have irreversible impacts on the planet. Unless these are hydrogen powered / e trucks, I am very against this option.. Military road and barcoo road are also not designed for heavy vehicle access, there are so many cyclists and runners in the area - creating a significant safety concern.
For all the reasons already outlined in 2.1 and 2.2. The disruption and damage caused by the installation and yearly operation of a fixed pipeline with limited delivery points will be adversely borne by northern beaches and is totally unacceptable.
I support a pipeline, I am open to the use of nearshore sand dredging as a possible source, but not convinced this would be allowed to happen by EPA
Do not support trucking sand unless it is short term
Dredge should be main source of sand feeding into a distribution pipeline along to beach to required location
Any solution using a pipeline is good one
Against temporary measures, we should be committing to a permanent fix.
NO PIPELINES
disruption and costly
No comment.
As per previous answers
Would erode the beaches here quicker
Non of these options are satisfactory for the environment or the people who use the beaches.

Why not recycle sand that has drifted from south to north and utilise trucks and pipeline to do so, and if needed, imported quarry sand. However, the obvious costs are associated with the import of quarry sand. This option does not seem to make any sense if we are trying to protect our environment.
It does not disrupt other beaches
This option has the same disadvantages as discussed for Option 1.1
This option seems less disruptive to beach users than the other pipeline options.
Same as other dredging options
Dredging
Do not support any kind of pipeline to move sand.
For environmental reasons you CAN NOT be dredging sand from near shore seabeds!
This would destroy Semaphore and Largs Bay beaches environmentally, socially and financially.
Trucks MUST stay OFF Northern Beaches!
This option MUST NOT proceed!
dont know enough about it but possibly could be a good solution given opportunity to grab sand from various sources
Disturbs seabed
Im against dredging
as above
No. Don't.
Would absolutely decimate the beaches and be devastating to everything on or near beaches
Sounds like a long term solution but could be costly to set up?
Damage the seabed and delecate marine ecosystem
costly dangerous an eyesore and erosion is happening all along the coast
do not agree with quarried sand
Same as before...
Again, strongly do not support trucks on the beach.
Maybe okay for a couple of weeks but it would be better not to dredge near the jetties, and better not to have trucks on the beach
Less invasive
High cost. High installation impact to beach. Regular marine disturbance. Quarry sand. No.
See above (2.1)
Negative environmental impact.

Pumping sand from one beach to another can only cause damage in the long run and degrade that primary beach
This has all the problems previously stated with dredging as well as the short term effects of installing a pipeline - I cannot see the point.
as before
I do not support pipeline, trucks, machinery or any infrastructure on our beach or through our dunes. Too invasive of environment both natural and and social/community.
Pollution from trucks
I did a school project on this exact issue and all the information I found said that the short term gratification (cheaper cost) of any dredging based proposal would not be worth the long-term environmental impacts and with this proposal we've spent all the money on the pipeline anyway.
Seems to be flexible, with minimal disruption and creates and sustainable circular ecosystem.
While scuba diving I personally witnessed damage caused by turbidity, sedimentation and reef smothering at Port Noarlunga reef due to previous dredging that occurred at Port Stanvac. I am completely opposed to dredging in SA waters because of the environmental damage it causes to coastal, estuarine and marine ecosystems, including reefs, seagrass and benthic marine life. In addition, water quality is likely to be affected and could lead to environmental nuisance where swimming occurs. It will also potentially have an economic impact on tourism and local small business, especially diving companies.
Noisy Disruptive
Expensive, unsightly, impact to environment, community and businesses
Not the right solution
No pipeline!
Effects of dredging on the environment.
I think it would kill the enjoyment of the beach
This requires a pipeline which will destroy the beauty of the beach and dunes and endanger the wildlife that inhabit the beach and dunes.
Enviromental impact from trucks on beaches wildlife, people and businesses
Definitely no pipeline as per previous answer
Expensive and environmentally destructive.
I suspect this option may be required in certain areas.
Can't see dredging is feasible and can't get in and fix storm damage which occurs quickly and still needs a mass fill, don't know where the source of sand is for dredging.
Dredging would have a high impact on the coast. Unlikely that this proposal would receive EPA approval.
It is not known whether there is a suitable sand deposit available.

Possibly impact water clarity (turbidity).
See above re quarry sand
The option here is to either dredge seagrass beds or take sand from the coastal zone with consequent impact on the eroding beach between Semaphore and Largs. It's also ridiculously expensive
Too expensive
Not enough evidence on long term sustainability of off shore sand supply
Will destroy fauna and flora. Make beach unusable at times.
Do not like the idea of using trucks to manage sand cartage as it seems as an inefficient and environmentally unsound way to manage this task and very expensive
Do not support trucking sand
There is a better option that is so obvious to anyone who has any knowledge/experience with our beaches. It's NOT rocket science.
The grain size and composition of sand is unsuitable as feed for a pipeline as significant carbonate component will break down into silt, it is unsustainable with rising sea levels. The pipeline produces significant volume of micro & nano plastics and delivers sand only onto the beach. It will not build up the beach profile which is necessary to prevent beach recession. It fails all of the goals of maximising sand staying on beaches, avoiding environmental harm and minimising community disruption while not being able to deliver the outcomes need for addressing erosion on Adelaide's beaches. Once again it is one of the most expensive options and does not represent good value for tax-payer dollars.
Significant impact on beach residents, users and general amenity
Per option 2.1
Cant see dredging as sustainable
Where will sand come from
Just shifting the problem to another area ... and can't be micro managed as easily ... and would work out dearer in the long term .. with regard to deliverability, environmental carnage, a greater political / community dividerer / interferer and limited sand source ... with some inevitable environmental marine decimation still likely.
Trucking again, it is environmentally not sound and it is not safe for our neighbourhoods to drive trucks up and down the roads from Largs to West Beach. Save our roads, kids, cyclists, and environment.
The discussion paper does not mention quarry sand. How hard is is to align the discussion paper and the survey!!!
As stated before, the quarry sand is one of the worst ideas.
I strongly do not support a pipeline or dredges sited between Semaphore and Largs jetties.

.
Environmental issues with seabed
I am worried about disturbance of the sea floor, and possible loss of sea grass. I also question the futility and ongoing expense of trying to intervene in a natural, dynamic system of Northerly sand drift. Houses at West Beach, Tennyson, Brighton and Somerton should never have been built on the sand dunes.
anything that uses pipes made of plastic is a no go, as it puts microplastics into our sand and water. Trucks on the beach and collecting stations are a no go. NO.
Absolutely no way to a pipeline being built, it will ruin the beach and this community and devalue our homes.
The pipeline is the most expensive option and not environmentally friendly
While the sand collection method seems simple and effective, I'm concerned the sand pipeline will not work.
ABSOLUTLEY NOT,
Expensive and dumb.
This option is expensive and foolhardy.. It would put huge pressure on the in shore area adjacent to Largs and Semaphore, decreasing the sand available to nourish the shoreline and therefore increasing erosion on an area of coast that is already eroding. It would also have a huge negative impact on the dune and beach system for over 14 km's. It would threaten and destroy the delicate dunes. It might appear that there is more sand in the northern beaches but it is disappearing faster each year due to increases storm activity. Those dunes support a delicate biodiverse environment of flora and fauna. It involves trucks on beaches and lack of access for beach users as well as potential danger of huge machines and trucks on the beaches. The sand produced via the sifting, piping etc is like fairy floss and will blow away in weeks. The pipeline will increase micro plastics in the sea and environment. False economy. A waste of money, time and energy not to mention the destruction it will cause. This option is a very bad one. NO NO NO to the pipeline. It should not even be considered. We want to protect all beaches.
very expensive to the state and with escalating climate change indicators likely to be ineffective in the near future and actively harmful to the northern beaches.
It will destroy sections of the beaches, be very disruptive during construction. it is likely to contribute plastics to the ocean at a time we are trying to reduce/eliminate them.
Environmental impact, beach disruption, cost
There is plenty of local experience that small/medium (ie 200-400mm outlet diameter) cutter suction dredges are not viable in the inshore waters at Adelaide unless protected by a breakwater. Also, turbidity associated with this kind of dredging is problematic, and there is insufficient space for settling ponds, which would be unsightly, unwelcome, and at risk of being breached during storms.
Better flexibility to harvest sand

I don’t think quarry sand should be used. This finite resource needs to be used elsewhere and impacts threatened land based ecosystems.
Do not support metro beach mining.
As long as weed beds aren’t damaged
Definitely not an option!
Environmental vandalism
No to collecting sand from near shore
Least impact to foreshore and locals affected by the scope of the works
Totally against the objectives of the panel, disruptive to the community, infrastructure left on the beach , micro plastics discharged into the gulf, a poorly thought through solution.
May be OK but I don't know.
Again this solution is extremely costly with little long term benefit. Mobile dredging on beaches and a pipeline will in the long term be detrimental to the Semaphore and Largs Bay beaches and dunes.
One of the less imposing options. A few questions: How far off shore? What is the impact to the seabed & sea life? How long will this be in place? How long will it take to construct the pipeline. What will be implemented to shift sand while this is being constructed?
as for 2.2
See above
This is expensive and the pipeline element will increase microplatic pollution. The dredging options 1.1 and 1.2 appear to have less negative impacts than this one that involves a dredge. The collection points would still be very disruptive and ugly and damaging, but the flexibility of a dredge is what seems to make this option not quite as terrible as 2.1 and 2.2.
Options 1.1, 1.2 and 1.3 look to be much less environmentally, socially and economically damaging overall than this option.
We do not want trucks or heavy equipment on our beaches. At all. Besides being unconscionably expensive, this proposal will not work. In fact it will defeat its own intention. As the piped sand becomes ever finer, it simply washes back into the sea near the shore, raising the water level and enabling the tide to reach further to the sea wall, undermining it.
Expensive. High environmental and community impact. Lacks the flexibility required to tackle a problem that is not fixed to one area
My overall preference is NOT to Dredge OR use a Pipeline - both are reactive solutions to the problem. My overall preference is to address the root cause of the issue (Climate change, Increasing Storms and Wave Movement) and create an artificial reef or breakwater ~1km offshore. Addressing the cause, not the symptoms is my strong preference.
Nevertheless, I have selected "STRONGLY DO NOT SUPPORT" for the following reasons: The grain size and composition of sand is unsuitable as feed for a pipeline as significant carbonate component will break down into silt, It is unsustainable with rising sea levels. The pipeline produces significant

volume of micro & nano plastics and delivers sand only onto the beach. It will not build up the beach profile which is necessary to prevent beach recession. It fails all of the goals of maximising sand staying on beaches, avoiding environmental harm and minimising community disruption while not being able to deliver the outcomes need for addressing erosion on Adelaide's beaches. Once again it is one of the most expensive option and does not represent good value for tax-payer dollars
I am basically opposed to the pipeline and would prefer trucks and dredges.
The pipeline proposal is so flawed with massive community, financial, viability and environmental drawbacks that combining it with dredging (a worthwhile solution) still renders this option toxic. As a Professional Engineer who has worked in a maritime industry for more than 30 years, I know that a pipeline system would be continually breaking down and would require excessive costly maintenance throughout its life. Further, a pipeline would cause ongoing enormous disruption and safety issues to all coastal communities. I have reviewed publicly available pipeline documentation and have concluded there are numerous flaws in its entire concept, viability and ability to deliver required sand. There is no consideration of climate change impacts. I have also learned of the negative environmental impacts of a pipeline i.e. generation of tons of micro plastic particles into the sea.
Social disruption environmental disruption plus cost
The grain size and composition of sand from the source is unsuitable as a feed for a pipeline as the significant carbonate component will break down into silt, It is unsustainable with rising sea levels. The pipeline produces significant volume of micro & nano plastics and delivers sand only onto the beach. It will not build up the beach profile which is necessary to prevent beach recession. It fails all of the goals of maximising sand staying on beaches, avoiding environmental harm and minimising community disruption while not being able to deliver the outcomes need for addressing erosion on Adelaide's beaches. Once again it is one of the most expensive option, one of the most disruptive to communities and one of the most damaging environmentally and does not represent good value for tax-payer dollars. The options with the most capital are the least flexible and flexibility is one of the key components to successfully managing Adelaide's beaches. Although this option has a small degree of flexibility, the hard infrastructure and high capital cost still makes it relatively inflexible and less suitable as an effective option.
The pipeline has a proven and successful methodology and long term success within the southern beaches along the Adelaide metropolitan coastline. The sand sources are known and available (within sustainable volumes if undertaken correctly). This solution is permanent and long term and will ensure the ongoing nourishment of all beaches within the management cell. This option will minimise the community impact through sand collection on the northern beaches and will reduce the sand currently accumulating around the northern beaches jetties.
Potential benefits
Provides opportunity for sand nourishment and equilibrium within the coastal environment
Sand would not be taken from the beach areas in north (only in the offshore areas) minimising disturbance to beach users

Would ensure appropriate sand volumes to protect assets and maintain beach widths
Minimises intrusion for the community within the northern beaches associated with sand trucking and heavy vehicles
Frequency of top ups would reduce the impact on our beach users, wildlife and our community
Opportunity for sand regeneration in other areas (such as Henley South and Joe's Kiosk) if required
Potential risks
Ongoing and frequent disturbance for beach users and residents in the northern beaches
Structures located within the beach environment may result in reduction of visual amenity of not designed and located appropriately
The location of the pipeline should be appropriate so as to not cause irreversible environmental damage to the established dune system
Risk of regulatory obstacles - EPA License and EIS
Microplastics are a likely result of the pipeline deterioration over the longer term
Residents and visitors on the southern beaches would experience adverse impacts associated with trucking and machinery associated with additional quarry sand being added to the southern beaches
Volumes need to be determined and agreed upon that returns Cell 3 to a healthy beach profile and then an adequate annual nourishment equivalent to annual loss
Persistent, annual inconvenience to beach users and taking sand away from an eroding beach is ridiculous.
expensive. damaging to semaphore/Largs beach. Disruptive
No to a pipeline!
I believe this to be an unacceptably ugly and noisy option.
Environmental damage to the dunes which will be caused by the construction of pipeline
Microplastics pollution
At risk from sea level rise
Relatively inflexible
Additional permanent infrastructure along coast
possible option but still involves digging up the beach/es to build a pipeline presumably
No trucks. there is already enough sand on the northern beaches, why access the quarries its completely ridiculous
Discoloured water because of the dredge
Pipeline and associated costs will blow out as time goes on.
Once again,environmental impact statement required.

Of the pipeline options, this would be the most politically agreeable. However, the cost would be an issue and again there is no mass fill.
Also issues as per dredging options.
Not a flexible system with poor environmental outcomes. e.g. microplastics with sand slurry in pipeline. Too much disruption with trucks and permanent infrastructure being built and very expensive. No proof it will work well for the cost and difficult to adapt to climate changes over time.
See answer to question 18
Pipeline using a temporary dredge and trucking quarry sand ($140-155 million) -STRONGLY DO NOT SUPPORT
Why ? The grain size and composition of sand is unsuitable as feed for a pipeline as significant carbonate component will break down into silt, It is unsustainable with rising sea levels. The pipeline produces significant volume of micro & nano plastics and delivers sand only onto the beach. It will not build up the beach profile which is necessary to prevent beach recession. It fails all of the goals of maximising sand staying on beaches, avoiding environmental harm and minimising community disruption while not being able to deliver the outcomes need for addressing erosion on Adelaide's beaches. Once again it is one of the most expensive option and does not represent good value for tax-payer dollars.
It this option comprised a majority of sand being trucked from land-based sources I would support it more strongly. Dredging from near shore sources is highly destructive of the marine environment.
Due to concerns raised with dredging, do not support this option. And no meaningful model available.
Pipeline and near shore dredging are costly, ugly and arguably inefficient in the long term
Perfect
Beach sand needs to be managed. I am happy for the experts to determine the best way.
Since the sand close to shore is already largely a barren, labile habitat (due many cumulative anthropogenic factors, historically and currently eg shellfish reef extinction, upper beach vegetation loss, housing on dunes, dunes removal, catchment management issues and sewerage outflows among others) its dredging would have less impact on the (similarly degraded) adjacent habitats.
Dredging is detrimental for marine life
Yes but again, where are you going to get the dredged sand
Answer is the same as above
As above- I am opposed to any trucking of sand from onshore beaches and from the near shore seabed. We can see the destruction at Semaphore beaches due to this practice and environmental advice is that an increase in big storms will further increase erosion.
I am opposed to a pipeline and collection stations as shown in above comments.
See above

Refer previous. Why is the gov't hell bent on destroying the environment to save a small section of sand that's only going to be taken away by nature again. Why Whay Why? Tell the residents to go to another beach. Rock beaches exist everywhere in Europe and their residents don't ask for us to have "sand" beaches.
Allows the seagrass to be monitored and sand levels in the targeted areas.
A temporary dredge can be used without a pipeline - which would be cheaper and less disruptive to the environment and to the community.
I've nswered this numerous times already.
Our beaches and jetties are tourist draw cards.
Why risk the income of our businesses
Ugly, disruptive and noisy for those of us who use the beach most.
Against pumping stations and large scale industrialisation ion the foreshore
Temporary means government support which changes with political party running the government. Something approved by one government is redesigned by change n more waste of taxpayers $$$$$
No pipeline
Same as 1.3
Although risking sub sea habitats, it seems efficient and less destructive than dredging alone. Sand is deposited on the beach allowing it to slowly move out to sea.
Pipeline.... collecting stations trucks NO
Sand suitability problematic, as well as impact of vehicles on beaches and cost is high.
Collection stations would create less beach
Huge constructions
Do not support
Again, as written before, a pipeline is damaging to the dunes, pumps out eroded nanoplastics, creates noise at the collection station, trucks make the beach unusable, is an eyesore, creates disruption, keeps beach goers away which is bad for tourism and local businesses.
The collection of sand seems to be slightly less intrusive, however, the construction of the pipeline and its associated infrastructure will be highly disruptive to all communities along its path. Micro-plastics will be deposited into the ocean and beach areas. Cost is the biggest and therefore less flexible. Pump stations and cooling towers will impact local residents and visitors to the area. Trucking sand has again all the environmental problems associated with trucks on roads.
• Desk top review and no modeling
• Impacts and uncertainty with dredging (as stated above)
Because I can't see how a pipeline can be installed without causing major damage to the dune & beach environment

The sand is too fine, it is a major disruption to Northern beaches, there are major negative environmental impacts. There is not one positive thing about the pipeline apart from taking trucks off of West Beach! West Beach is not a major attraction point, with no jetty, main strip, or community grassed areas - unlike Semaphore beach. Semaphore is a major/popular beach, attraction, and meeting location for many families and communities of the Western and Northern suburbs. Semaphore holds decades of history and is well loved by many in Adelaide. Having trucks, sand carting, or a jetty closed will stop many from continuing with their daily recreational and calming activities like walking, fishing, meditating, running, bike riding, and so many more. I don't understand why you would want to ruin a very popular, major beach to save a beach with no major history, recreational activities, or popularity to SA. I urge you to perform a survey of those that attend Semaphore vs West Beach throughout the year... this may cause you to rethink this decision.
1. Any sand taken from Semaphore, Largs and Taperoo beaches is not being 'replaced' at a reasonable rate. There does not seem to have been any consideration of replacing sand on these beaches when they have been ruined.
2. Pipeline infrastructure is large, noisy and makes sections of the beaches permanently unusable. This is unfair to beach users, and is not a solution which considers the longer term.
3. Pipelines required trucks on the beaches permanently. This is unacceptable.
Any near beach dredging involves unacceptable environmental disruption. any pumping solution is too disruptive.
We are adding trucks to our beautiful beaches, the mess they leave is a hazard when trying to walk along the sand
It is a plastic or similar pipeline carrying course materials that will leach into the sand and ocean. An eyesore for residents and visitors. Disruptive to community and wildlife. Loss of habitat for wildlife.
Will create more erosion and damage infrastructure + be a safety hazard to beach users.
It won't work and it will ruin what is already here, and people have put in a lot of effort to reinstate and maintain.
Costly infrastructure required which will damage northern beaches and fragile dune systems , Inflexible to adapt to rising sea levels.
Produces unacceptable, large volumes of abraded plastic pipeline microplastics to the marine environment over its life time.
As above for a pipeline.
Damage to sea grass beds and loss of sand on northern beaches and dunes
See comments Option 2.1
As per answer 15. Trucks on beaches would disrupt communities. Beaches and dunes will be destroyed. Ineffective as sand directly on beach does not stay. Micro and nano plastics will pollute the environment.
My responses to options 2.1 and 2.2 apply to this option 2.3 as well. Depletion of near-shore sand and destruction of near-shore ecology are not sensible environmental practice especially in light of

the current parlous state of the seagrass and the increasing impact of climate change. I do not support any option involving a sand pipeline because of destruction of dunes, disruption to community enjoyment and the resulting negative effect on the income of the many local businesses which rely a great deal on visitors to the beach.
Pipeline
1. HARMFUL AND DEVASTING LONGTERM IMPACTS TO OUR COMMUNITY. THREATENS THE FOLLOWING -
a) Loss of tourism, loss of community space, loss of community well-being due to invasive and destructive annual practice of quarrying sand from beach or near shore areas.
b) Negative Impact to local businesses of Semaphore and Largs Bay during winter when business is marginal at best (i.e., role of beach, dunes and foreshore in visitor economy and supporting local business activity)
c) Damages the role of the Northern coasts in identity of place (i.e., activation of beach and community activities in dunes and foreshore)
d) Loss of Public safety (i.e., truck movements on beaches at 40kph equal to Semaphore Road, excavations on beach and intertidal zone);
e) Loss of Public amenity (i.e., noise, truck speed, beach closures and nuisance impacts);
f) Detrimental to Natural environment and increase in coastal erosion (the removal of sand from the beach and tide zone creates a relative sea level rise by localized lowering of beach, storm surges then destroy dunes because the ocean can reach them).
g) Accelerates threats to local infrastructure by destroying our first line of defence from storm surges – beach and dunes
h) Loss of beach/jetties access for sports, leisure, and mental health
i) Accelerated coastline loss, dune recession and destruction
j) Impacts to flora and fauna (environment)
k) Increased Noise and air pollution from trucks, pumps, excavators
l) Works against nature, invasive, destructive
m) Impacts to local recreational fisherman and crabbers when considering extracting from around jetties or between jetties.
n) Pollution and health risks from nano plastics created from transporting a quartz slurry thru a PVC pipeline
o) High capital costs that impact community as taxpayers
p) Not flexible meaning the damage will be unsustainable and ongoing until project failure/termination/abandonment. Internal sand has proven ineffective in maintaining and sustaining West Beach. nd there is no modern evidence that Northern beaches are receiving sand from West Beach, in fact the coastline is now eroding.

A pipeline will wreck the beaches. Much too expensive for dubious outcome. The impact of more man-made and intrusive structures is too costly to the environment
I don't support the Pipeline options because of the significant environmental impact that this permanent structure will have when being build in the dunes or along the beach but also when it will be used with all the detrimental effect of micro plastic for example and not to forget what we would also legate to the next generation when this infrastructure will arrive to its end of life.
This is also a very expensive option with a number of technical downsides (transport of fine sand that don't stay on the beach, limited sources of sand where it will be taken on the Northern beaches while this sand is needed to protect the coast there against the increased storm pressure).
Insufficient detail, may endanger local seabed sand reserves. May be aesthetically unappealing.
Costly ongoing short term solution
Still dredging is not ok
I do not support any option involving a sand pipeline because of the detrimental environmental impact and negative impact on the community.
Impact on dunes and Adelaide beaches is too strong with pipeline options
A pipeline is NOT a solution. Plastic pipe = micro plastics straight into beach, environmental impact, trucks on the beach, maintenance costs to taxpayers, LOSS OF SAND FROM LARGS!!
Close beach to install pipeline. Noisy and environmental impact is bad
Pipeline is expensive and will damage the beach environment across entire Adelaide metro coastline. Delivery of sand directly onto beach is less effective than near shore deposit utilising natural wave motion.
See previous answer
See previous answer for 2.1 and 2.2 and add, a very very expensive option for assured failure, environmental destruction and unhappy communities up our end.
- The environmental damage of building the pipeline would be irreversible - impact to sand dunes and local coastline
- Information from Digital Earth Australia (DEA) shows Semaphore and Largs have actually LOST sand since 1988, furthermore the sand is fine and does not stay on West Beach
- DOES not take trucks of beaches
- 3-4 months of the year the beach would be subject to trucks and heavy machniery on beaches - who would make a decision to do this on popular beaches that are used ALL year round (Semaphore and Largs), how can this be considered an equitable solution
- The pumping stations would be noisy, ugly and impact local residents and businesses
- Long distance to pump sand, the cost of running let alone the environmnental impact of running and maintaining would be totally ridiculous

- Has the impact of the plastic deposits from the pipeline into the ocean been considered and what this would do to our ocean species
- Pipeline is the MOST EXPENSIVE option by far
- Maintaining the pipeline and pumping sand would be a huge cost and massive impact to the local community and South Australians that frequent the beaches where the sand is being 'harvested'
- Pipeline DOES NOT FIX the problem for beaches loosing sand it is just a solution to Rob 'Peter' to pay 'Paul' at a significant environment and community cost
- Nothing positive about the pipeline solution
Pipeline
1. HARMFUL AND DEVASTING LONG-TERM IMPACTS TO OUR COMMUNITY. THREATENS THE FOLLOWING -
a) Loss of tourism, loss of community space, loss of community well-being due to invasive and destructive annual practice of quarrying sand from near shore areas.
b) Negative Impact to local businesses of Semaphore and Largs Bay during winter when business is marginal at best (i.e., role of beach, dunes and foreshore in visitor economy and supporting local business activity)
c) Damages the role of the Northern coasts in identity of place (i.e., activation of beach and community activities in dunes and foreshore)
d) Loss of Public safety (i.e., truck movements on beaches at 40kph equal to Semaphore Road, excavations on beach and intertidal zone);
e) Loss of Public amenity (i.e., noise, truck speed, beach closures and nuisance impacts);
f) Detrimental to Natural environment and increase in coastal erosion (the removal of sand from the beach and tide zone creates a relative sea level rise by localized lowering of beach, storm surges then destroy dunes because the ocean can reach them).
g) Accelerates threats to local infrastructure by destroying our first line of defence from storm surges – beach and dunes
h) Loss of beach/jetties access for sports, leisure, and mental health
i) Accelerated coastline loss, dune recession and destruction
j) Impacts to flora and fauna (environment)
k) Increased Noise and air pollution from trucks, pumps, excavators
l) Works against nature, invasive, destructive
m) Impacts to local recreational fisherman and crabbers when considering extracting between jetties.
n) Pollution and health risks from nano plastics created from transporting a quartz slurry thru a PVC pipeline
o) High capital costs that impact community as taxpayers

p) Not flexible meaning the damage will be unsustainable and ongoing until project failure/termination/abandonment. Internal sand has proven ineffective in maintaining and sustaining West Beach. We must seek external sand to maintain beach position.
This option has the same negative components as option 2.1 and 2.2, only difference is that there will be no excavator on the end of the jetties, cost is also not justified, very expensive for tax payers and harmfull to the environment, Environmental Impact Study required.
As per Option 2.1
I don't support any pipelines thus causing destruction of sand dunes and beaches.
NOT GOOD FOR ENVIORNMENT ESPECIALLY WHEN YOU WANT TO SWIM
still involves trucks on beaches and costly
The grain size and composition of sand is unsuitable as feed for a pipeline as significant carbonate component will break down into silt, It is unsustainable with rising sea levels. The pipeline produces significant volume of micro & nano plastics and delivers sand only onto the beach. It will not build up the beach profile which is necessary to prevent beach recession. It fails all of the goals of maximising sand staying on beaches, avoiding environmental harm and minimising community disruption while not being able to deliver the outcomes need for addressing erosion on Adelaide's beaches. Once again it is one of the most expensive option and does not represent good value for tax-payer dollars.
Pump stations and pipelines are unattractive
Best way to continue operations without being de-funded
creating permanent infrastructure protects our beaches from future de-funding
In addition to the reasons for not supporting previously mentioned, the pipeline option is ridiculously expensive.
permanent infrastructure needs to be developed to protect the beach management from future de-funding
Dredging options and quarry sand as previously stated
Again trucks at one end and not the other to avoid activity in areas of political appeasement . A means for government to play to its base.
The pipe is the solution to transfer the volumes of sand required but again easier and more reliable regardless of the weather or tide to collect of the beach near the waters edge
Similar to 2.1,Use of a dredge will be preferable, however there will still be machinery on the beach-to feed the pipeline-so not supported.
There will still be pipelines and and pump stations-so not supported for the same reasons as mentioned in 2.1.
Also there will carting of sand to West Beach for 5 years, because there is insufficient sand at Largs and Semaphore-which is disruptive
too much damage to each

Still mindful of dredging on the near shore.
Once again the environmental protection of the seabed from the dredging, in particular the sea grasses, and the impact of the pipeline are questions.
No definition of quantity of trucked in sand and dredging, do not support either way for reasons as stated in above options.
Because of information I have read from Save Our Shores (SOS)
Not so sure about this-it's still a pipeline
This option cannot go ahead. It is extremely damaging to the dunes, is not a long term option and will create destruction during its installation, operation and removal. This option has received continued angst for good reason and the community must be listened to. You cannot put something of such hard infrastructure through what are extremely weak and fragile dunes home to endangered species and plants. This option also does not take trucks off the beach. In conversations with residents around the existing pipeline have expressed their disgust regarding noise and visual pollution and overall dissatisfaction from the pipeline. Do not allow this option to happen. Listen to the community, please.
Expensive, noisy and unsightly.
Environmental impact on seabed.
I support the pipeline component. I don't support dredging the marine floor for several months of the year annually. I don't support the long-term reliance on quarry sand as this is (a) unnecessary as there is plenty of sand available on the northern beaches, and (b) quarrying sand is much more expensive than just collecting it from where it accumulates on the northern beaches and feeding it into the pipeline.
Pipeline is going to damage dunes. Too expensive. Water waste. Heavy machines on the beach. Lots of trucks. Short lifespan. Northern beaches are eroding already without harvesting and pumping sand
I do not support the pipeline option
Once again. NO PIPELINE THROUGH OUR BEACHES. I DO NOT WANT TO SEE ON ANY BEACH A SAND SIFTING MACHINE BLOCKING AN AREA ON ANY BEACH. METAL MACHINES DO NOT BELONG ON BEACHES. BECAUSE THEY RUST AND ITS AN EYE-SORE. There is a much more heaper and more successful way of doing this.
Disruption to beach users

Please explain your level of support for Option 3 - Trucking sand from beaches and quarries'

This option has on-going emissions production from a boat and truck powered by fossil fuel. A fix needs to be i place that has little or any on-going work or labour requirement. Also visual and noise impacts.
seems an expensive way to do it but i am not across the economics
Quarry sand is not beach sand. Furthermore, using heavy trucks is not environmentally friendly and will cause noise and fumes pollution to local residents as well as traffic problems.
This option places machinery on the beach. The beach harvesting sand pump options also place machinery on the beach along with permanent infrastructure. I see this option as the superior choice when it comes to options that have machinery on the beach.
I note the considerable additional cost to the option 1 dredging, however I suspect, and this is without any form of research, that option 3 will be required at times to supplement the option 1 dredging
This is how its currently done.
Apart from the "not in my back yard" people who call all options "Sand Mining" which it is not. It does work and the community cooperates with it.
Wasteful.
n data presented :
- very high cost (Estimates are selection phase so little engineering completed to get to better than +/- 50%
- heavy vehicles on local roads and beach access points
- impact on local residences and beach goers
- large environmental and social impact
Support what ever is required to maintain a usable beach.
Have been doing this for years.
Cost, practicality, traffic
Too expensive, not sustainable, too many trucks on local roads
Trucks would make the beach less attractive/relaxing. They may also impact access to the beach.
These large pieces of machinery damage beaches in and of themselves, plus they are removing sand, which inflicts further damage on beaches.
Would only support 100% of sand coming from quarries. There are plenty of quarries in SA (not just at Mount Compass) and over 4 million tonnes of sand are mined in SA each year.
This method impacts significantly on beach users and damages the beaches at collection sites. Trucks & excavators on the beach is dangerous (I have witnessed this over many years). It is

environmentally damaging due to diesel exhaust emissions and uses much more fuel than other options. It creates hundreds of extra truck movements both on the beaches & on the roads. We need to stop using this method.
Sand needs to be moved back from north to south.
Not effient over the long term, costs will only rise over time for labour and machinery
Significant reduction in amenity over substantial period of time, high cost.
nothing good about this option
As above
I think it is better to use local beach or ocean sand than to use quarry sand
We have this option now and aren't using it
Hasn't worked in past and costly
Trucking is expensive and disruptive to beach use and has resulted in significant destruction of Semaphores dunes and beaches.
Inefficient. Disruptive. Trucking should not be part of the ongoing solution.
Irresponsible, carbon intensive , ineffective, road traffic
Is not sustainable and highly disturbing
NO TRUCKS !
Quarry sand does not belong on beaches. Dredges will degrade the ocean bed and disturb plants and animals that live there. The environmental effects need to be considered ahead of people's desire to have sandy beaches.
Much better solutions available. This is an embarrassing environmental message to the world.
too expensive
Ongoing truck activity is noisy, destructive to roads and the peaceful beach environment.
Less trucks on any beach is a better option but even with all the sand dumped on West beach over the last couple of years it is not enough.
Applies all the worst options of those available to no benefit.
disruptive
As above
This is the status quo. Expensive, not working, leaving both ends of the coastline unhappy.
Very disruptive, dangerous to beach users and polluting. Also prevents use of west beach boat harbour beach for significant periods
Trucks on the beach at West Beach are only good for the sand carting company dollars.
Most inconvenient to beach goers and the Plovers that are supposed to be protected
Environmental damage. Quarry sand is not beach sand

A lot of disruption to beach goers and the surrounding amenities
This sounds like the most environmentally sound option, and the best for beach enjoyment. Forget dredging and installing big pipelines.
Quarry sand component is not sustainable and cost effective
This is back to the historic methods and unlikely on its own to achieve the volumes required.
So such is really only part of the overa long term solution with the road wear and tear and residents disturbance issues.
No mining on our suburban beaches. Do not destroy one beach to save another.
It's not safe for beach users and it's damaging to the environment
it was never great but it has been getting steadily worse and worse for beach users. its intensive and ineffectual. you need a lot of sand to slow the rate of erosion and quarry sand is expensive. the hidden costs of sand carting from beach to beach is no longer socially acceptable (if it ever was).
Trucking does not work as we have seen under this government
Current practice that can adjust to local circumstances with least impacts on dunes
I do not support using Quarry Sand
Slow and expensive.
There was not sufficient information in the discussion paper to make informed input. There was no assessment of environmental impact of options or carbon emissions impact. There was no long term system change options presented. There was no explaination of why other options were not assessed. The options represent status quo and are not suitable options.
Large trucks on the beach are dangerous. I do not support mining dunes for sand
moving beach sand from beach to beach Has Not worked.
Trucks are noisy, intrusive, cause traffic congestion etc.
Trucks and beach life don't mix. Also quarrying in unsustainable
Too disruptive
Continuous disruption to beach users
Criminal to use sand mining on any beach
Support only with quarry sand, not beach sand
You ruined Semaphore beach by doing this. You will not be doing this to Largs Bay beach or any other beach north of Largs. Really disappointing and sad to see beautiful semaphore beach and sand dunes ruined. Will take years to fix itself.
I'd only support sand trucking if from quarry sand only. DO NOT DESTROY ONE BEACH TO TRY AND 'FIX' ANOTHER.
As above

many trips, more pollution, more heavy vehicles on the road, damage to roads, sand spillage on road, noise of trucks, loss of access where vehicles are operating etc
Only if using 100% quarry sand
Labour intensive and hazardous for beach goers
1) cost
2) disruption
3) use of trucks
As above.
Need more green and eco friendly environment s while supporting local work force and economy's
Finite resources, high emissions and disturbance. Again, without recirculation, this only benefits Northern beaches and doesn't secure the long term survival of the South.
Economically and environmentally destructive and will just add to the build up of sand and the northern beaches. The problem is the drift of sand, not a lack of sand. Adding more sand will just add to the problems further north. The sand simply needs to be pumped back south to compensate against the poor design of the man made break walls along the coast that are creating these problems
Environmentally devastating to have sand carted from northern beaches - this would cause irreversible environmental damage to northern beaches
Significant Environmental concern for local northern beaches and financial concern for northern beaches businesses
This is also not the best option. Will cause disruption and ruin beaches
Beach sand preferred - excavators can manage and restore to almost natural -weather can do the rest
I support using quarry or other 'new' sand but there is NO EXTRA SAND on northern beaches. In fact Semaphore South is eroding due to the collection of sand at the groin. This sand should go to Semaphore South.
Quarry sand could be placed as required at West Beach or Henley South by small pump that directs it out beyond low tide zone. This would limit trucks on their beach.
We must also work to REDUCE SAND LOSS by other means - as is done internationally. Such as sand being placed out in the water and not on the beach as it is eroded more slowly from there.
Would support quarry trucking
Its a temporary solution and will not be popular amongst residents
Trucks on beach make beach unusable and excavation of sand on beach greatly damages the beach where sand is being taken from and leaves it susceptible to erosion.
Trucks on the beach are awful

Sheer madness to increase heavy vehicles on roads that are already well past their sell by date, with poor signage, line marking and potholes.
The could be the less disruptive option
Its been working for years but seems costly
Only for quarry sand
Once again - lumping beach sand with quarry sand. Quarry sand is the only viable option. Don't destroy our beaches when you have no hope of saving West Beach.
I am not opposed to quarry sand being used although it still means West Beach will have trucks and the sand will be put on the beach to be washed away with the next high tide.
Truck, sand planes and excavators on a much loved and frequented local and tourist beach for at least 4 months of the year makes no sense.
On Page 5-A(I) of the information provided it states the sand will be collected between the lowest tide level and the base of the dunes to a depth of between 300 and 1000mm! This is equivalent to over a hundred years of sea level rise in 2-3 months. How can this be environmentally sustainable? In the last 2 years of sand removal at Semaphore/ Largs the dunes receded by at least 14m, confirmed by James Guy of The DEW at the time. According to satellite imagery released recently- Semaphore beach has receded 70m since 1993 and Largs beach has lost 30m since 2016.
The sand is not floating up the coast and landing at these beaches as reported.
It has been shown in numerous report's including the DHI report for The Dept of Environment and Water that the sand North of Largs jetty is much finer than West Beach sand and therefore washed away quickly and in fact from the swirling action can cause more erosion. Another reason why coarser quarry sand is a preferred option.
I wouldn't rule this out as this can be an emergency option if extra sand was needed because mother nature was messing with our beach.
https://climate-adapt.eea.europa.eu/en/metadata/adaptation-options/groynes-breakwaters-and-artificial-reefs
Adelaide shores should never have been built
Trucking quarry sand is expensive, disruptinve & non-sustainable.
Short term solution only with disruption to beach users.
Terrible look for tourists and beach goers. Absolute eyesore and diesel fumes and degradation of beaches
Concerns about safety of trucks around kids in beach. It's hard to handle already when the trucks have been there. Also when sand is piled onto the beach sometimes there are voids underneath that some people can fall into- already seen them myself - and it's pretty impossible to keep kids and dogs off the piles or hills
Doing what we do now seems to be the best way to protect the environment while still having good beaches. Our beaches need to be kept as natural as possible

this has been somewhat successful to date but it is timely to move on.This is the goal of the review .
It establishes the benchmark of budget .
7 million /year for 20 years = 140 million dollars
Onshore sand is better used by industry. And no trucks please.
Sand should not be taken from existing beaches
Not a long term solution
If trucked from quarries maybe sustainable, but not Northern beach sand, which has done so much damage already to the dune system from Taperoo to Semaphore.
Opposed to trucking and taking sand from one beach to another creates more problems.
As above
High impact on beach users and residents
Must be supported for sand to be recycled. Not the preferred option.
No Govt can continue to fill the Northern Beaches without recycling sand. Quarry sand is far to expensive to be sustainable.
Choosing this option sadly generates ongoing significant disruption with trucks working at source, on roads and delivery destination.
Wrongly has ongoing disruption embedded into the future of West Beach without a respite period of time.
Turns our beaches into quarries.
Will impact beach amenity too much.
Needs large machinery and will cause loss of access to beaches due to stupid regulations.
We can't keep having a solution where trucks are working on beaches in summer.
It's not a long term solution and I want to see an end to sand carting trucks on our local roads from West Beach to Largs Bay.
if areas could retain the sand and doesnt cause a major issues from were its taken then yes
This is not a long term solution, polluting and hugely disruptive.
This is the worst option. It is extremely disruptive to the environment and beach access. Ultimately the truck movement on the beach is a risk to pedestrians despite the drivers taking care.
Once again, how long would quarry sand supplies last, supplying to such an endless attempt to appease West Beach residents/
West Beach residents (again as I have been led to believe) have already been punished by the building of marinas for the wealthy, boat ramps etc which detrimentally effect the natural northward drift of sand along our beaches replenishing them?
Here it is proposed that, instead of punishing beach-side residents to their north with beaches scraped bare, periods of huge industrial and dangerous activity either on our beaches or the end of

our jetties plus much of 16 kms of our dunes destroyed, West Beach residents must further be punished by massive trucks along their streets.
Better than a pipeline, but everyone hates the big trucks on the beach.
Should not introduce quarry sand.
Appears to be a more environmentally damaging and expensive option with higher disruption, carbon footprint and beach user safety and accessibility impact than other options. I see this as poor solution technically and environmentally and not cost effective.
Terrible option - pollution, disruption, terrible use of resources. STRONGLY OPPOSE!
Removing sand from the beach will damage the environment and be invasive to the beach.
Seems to be the least “destructive” solution
Disruption to the beach noisy excavators and trucks
so much machinery, so much co2, so much habitat loss, taking sand from one place only moves the problem.
Short term solition that only gets washed away.
Proven to not work and too disruptive
I feel very strongly that the decision on how to treat our beaches must NOT be in the hands of just anyone. These decisions must be made by people with marine and environmental science expertise. We need to use the best system according to what the science says to help fix and protect our beaches.
Bringing external sand just adds to the sand build up problem at Largs North and North Haven. It will impact the Outer Harbour entrance in time and have a significant commercial financial impact on SA.
Object to level of public disruption. Object to use of quarry sand .Prefer natural offshore sandbank source for sand
Less trucks the better. Pumping appears preferable.
I am absolutely opposed to any sand being removed from the beaches. Sadly they are not as impressive as they were in 2005 due to the sand carting and erosion from inclement weather.
Too intrusive and very expensive
Too much sand at Largs North
Prefer Sand already in the "Beach environment".
Increased heavy traffic along beach roads will damage local roads
No to sand mining and trucks on our beaches.
This would only be a acceptable if all course grained sand from quarries was used but it won’t be so I can’t support it.
Trucks are dangerous on the beach

Will support if only 100% quarry Sand
There is already sand in the system in the northern beaches. Quarry sand should only be sourced as a back up. Sand will continue to flow north, this sand needs to be recycled so that we have a sustainable system. Trucking is harmful to the environment and expensive. This will cause ongoing disruption to West Beach with constant trucks arriving and unloading.
Rediculous.
I do not support sand carting from the beaches. The behaviour of some of the contractors has been appalling and dangerous. I have observed this over some time and unfortunately it is true and there have been close calls with people, animals and vehicles. Sand carting from quarries would be OK if managed properly
Only support if the sand used is 100% quarry sand.
If done safely it would be good
Only support if 100 % quarry sand (no beach sand)
It 100% helped West Beach previously.
This seems to be the less intrusive method of those listed.
Not Sustainable
Not efficient
Not acceptable to have 100+ SAND TRUCKS pass 7-8 meters from our club, community and hospitality business EVERY DAY
Only support if 100% quarry sand (no beach sand)
Short term solution only
Not preferred but second best option to pipeline. Expensive and dangerous however
The quarry sand is likely in the future to be way too expensive as it is already 10x the cost of sand on the beach, but recycling sand from the north makes sense. The recycling of sand is the answer for long term, cost and environmentally effective. We still need a mass fill to maintain a 1970 base level. This should use minimum truck movement using northern sand.
Disruption to beach use and short term fix
Only support if 100% quarry sand (no beach sand).
Environmental concerns
Problem with member for Semaphore not suppoting other beaches like West Beach to get their lost sand back after drifting north. They are stockpiling huge amounts of sand in an artificial dune and planting on top, which blocks everyone's view of the beach.
Obvious more machinery on our roads and beaches
this places no impact on the whole harbor, bird island, mangroves and historical and cultural environment. we should be selling this whole area to the world to show how cities can live alongside

the natural environment and the environment can grow and thrive. isn't adelaide suppost to be the sustainable city?
See item 19 above.
This option is absolute minimum requirement & has already been used as a temporary fix - not sure it is a viable long term solution due to the dangers of heavy machinery moving around & the adverse reactions already seen at Semaphore & Largs ....
Not sustainable
Quarry only
$$
see previous
Only use of quarry sand would encourage my support
Expensive and only viable if only 100% quarry sand is used.
Dont want trucks on the beach disrupting beach goers and local residents
see response to 2.1.
I oppose heavy equipment on beaches and sand carting for reasons stated above (heavy sand trucks & equipment rattle my house along Bower Rd). I also oppose the collection of sand from Semaphore region as, even though in your info material it states otherwise - there is a very REAL problem of erosion at Semaphore beach. It's clearly eroding and getting worse when its being taken from Semaphore South, the sand is not able to build up at Semaphore beach itself.
This is current practice and must not continue as it environmentally unfriendly and unsustainable.
Social impact, noise, safety, level of disruption and cost with infrastructure on jetties, collection stations and trucks on beaches
We have lived through this option, and it was awful for the above reasons.
Stupid
No trucks on beaches
Only if 100% quarry sand used no beach sand
Only support partially, trucking sand is better than nothing but should be viewed as a temporary stop gap while a pipeline is installed. Not a viable long term solution
Expensive and inefficient
If no pipeline this needs to be done
This method would be very disruptive to the road system and traffic along the coast. These roads are not built for large vehicles
Only if quarry sand, not beach sand. And certainly NOT from the Lefevre Peninsula beaches.
To invasive on our beaches. Visually unattractive and disturbs peoples access to beach.
This clearly hasn't worked and must cost a fortune.

Antiquated system and costs will blow out over the next 20 years. Plus its awful being o the beach with big trucks constantly driving past. Ok for emergencies only
Definitely do not want trucks and heavy equipment on the beach. The Department of Environment has already destroyed the beach nesting sites for red capped plovers at Semaphore South, it would be good to recover this habitat for these birds rather than making a permanent habitat loss. Past experience of sand trucking and excavations have left our beaches in an unusable state for beach walking for many weeks of the year as well as contributing to erosion of the foredunes and loss of vegetation. In my view it's environmental vandalism and the community has demonstrated that there is no social licence for this activity.
Long-term ongoing delivery of quarry sand has - explicitly - not been shortlisted, so this option must presumably revert to 100 percent beach sand over time. The integrity of this option must therefore be questioned.
Trucking sand is a disruptive, environmentally unacceptable, suboptimal solution.
Harvesting sand from the northern beaches by excavator and front-end loader has been proven to be completely unacceptable, non-viable and environmentally damaging by operations carried out in recent years.
I do not support the use of heavy vehicles on beaches for the safety of both the environment and the beach users. Extremely expensive ongoing costs
I do not support trucking sand from beaches.
Maximum disruption to beach amenity and should not be considered apart from a stop gap method.
Unsustainable with rising sea levels, delivers sand only onto the beach which is only a cosmetic effect and very temporary failing all international metrics for renourishment durability. Expensive and utilises a diminishing quarry sand resource which will increase in price.
Trucks are ugly smelly dangerous. The sand has been eroding from all beaches so one beach should not take from another.
I am in the unenviable position of having witnessed the wholesale destruction of Semaphore Beach first hand thanks to sand mining.
For months on end, trucks and sand planes gouged the beach between the jetties; at times the ruts so deep as to make accessing the water's edge impossible.
And for what?
The sand is too fine for the job you need it to do. End of.
ONLY IF ITS 100% quarry sand. That means NO beach sand.
only quarry sand, no beach sand, will work
Trucks on beach dangerous
External.sand
Only support if 100% from quarry.

Expensive and road hazard making dangerous
Too much machinery, too much risk, too much disruption to communities.
If we are moving sand for our own enjoyment of beaches and protection of our homes and infrastructure then we need to accept disruption to our lives - not expect marine life to suffer as a result of our needs and wants.
External sources of sand, quarries - where are they located? Where are future sand quarries located?
We have experienced years of sandcarting, and are firmly opposed to it. There will be strong community pushback on this. There are a number of reasons: the Le Fevre Peninsula is subsiding and one of the most vulnerable areas to climate change in Australia. Where is this mentioned in the technical report? As we will be heavily affected by climate change, need to shore up our dunes and beaches against increase of significant storms. Previous attempts to move sand in winter (as suggested in the technical report has lead to more erosion of our beaches during intensive storms) since there was reduced sand buffer. Intensive sandmining has caused permanent erosion, and has been badly managed by the Department for Environment and Water (DEW). DEW has broken promises to community consultation groups, there have been key safety issues and conflict, damage to the dunes by trucks (despite strict rules). Semaphore South cannot afford to provide more sand (major erosion there because of the breakwater at Point Malcolmholding back the natural flow of sand to Semaphore South dunes). The Largs Bay sand is too fine and quickly washes away at West Beach. It is clear that larger grained quarry sand is more effective in staying on shore but even that washes away with a storm. Another solution is necessary, such as depositing sand near shore rather than on the shore. Recent research from DEA Coastline data set Annual shoreline 1988-2022 shows that Largs Bay has lost 30 metres since 2016, and Semaphore has lost 70 metres since 1993, so the DEW projection of littoral drift of West Beach sand to the northern beaches is misleading and simplistic. I can only consider this option if ALL sand used is sourced directly from quarries.
I want trucks off beaches
Slightly better than the pipeline but still not ideal.
Expense and emissions.
This error reduce the build up of sand on the northern beaches (north of Largs jetty and north haven)
This option is not cost effective and involves using heavy machinery on suburban beaches, presenting a risk to beach visitors.
Damage to the work area
support this option ONLY if the sand is 100% quarry sand and not beach sand
Disruption to beach users.
Again what are the environmental impacts? I support the option with the least negative impacts
Only support if 100 percent quarry sand (no beach sand)

See 1.1 explaining why this is opposed and the evidence to support this opposition.
Do not want to see excavators & front end loaders on the beach
There would be a massive impact on and degradation of the beaches from which the sand is sourced.
There would be a huge negative impact on visitors and residents of the beaches from where the sand is extracted. The abrasion of sand inside a plastic pipeline would eject nano plastics into the marine environment. All the beaches between the collection point and deposition point would be excavated for said pipeline which is an abhorrent notion. The compaction of our beaches by heavy vehicles will also be disastrous for the beach ecology inc disruption to bird life, macro invertebrates, disturb the natural hydrology of the beach and contribute to increased frequency of localised higher tides. The sand in situ at proposed collection points is a natural line of coastal protection to assets owned and utilised by visitors and residents. We cannot afford to reduce our beaches in view of climate change and the increased frequency in king tides and storm activity. Beaches MUST be protected.
Trucking sand is not environmentally sustainable
Try to confine disruption to the area of the problem or near by and not disrupt more remote locations
Dont like this option but if it is the only available option then I would support it
Not a long term fix
trucks as a constant source of supply disturbs residents at both ends
Expensive, destroys not only beach but environment when quarrying, disrupts usage of beach, unsightly, dangerous having trucks on beach for beach users
Quarry sand is likely to be cost prohibitive vs cost of beach sand. That said, recycling sand from the north to the south is the best option and is environmentally effective. We would require a one off mass fill to deliver a 1970 base level. This would minimise ongoing truck movement using northern sand.
Long-term ongoing delivery of quarry sand has - explicitly - not been shortlisted, so this option must presumably revert to 100 percent beach sand over time. The integrity of this option must therefore be questioned. Trucking sand is a disruptive, environmentally unacceptable, suboptimal solution. Harvesting sand from the northern beaches by excavator and front-end loader has been proven to be completely unacceptable, non-viable and environmentally damaging by operations carried out in recent years.
This seems to do the same thing as options above, but significantly increases Greenhouse gas emissions. Given the current climate issues, this does not seem like a good idea, unless all of these vehicles become electric.
this sounds very laborious, and might use a lot of resources to make happen
As above

This option was the method used for many years. There were public safety issues and high impact on roads and houses along the sand carting roads. It caused many ongoing complaints to the Minister.
Trucks are a nuisance and hazard on our beaches. The presence of trucks has a significant negative impact on how a large number of community members can use our beaches (especially over the winter months). The unpredictability of where and when they are working is an annoyance. Trucks are highly undesired.
Mining and trucking sand is environmentally and socially intrusive. Having heavy machinery on the beach ruins it for people, creates sand cliff hazards and creates ideal conditions for erosion. As we know taking sand from any beach weakens the dune system behind it. Not only do these dunes protect the northern beaches, they are valuable ecosystems which are home to many plant and animal species, some of which are already rare. To do this when the Lefevre Peninsular is known to be slowly sinking and there has already been a recorded sea level rise puts beaches further north along our coast at unacceptable risk.
Trucking sand isn't a permanent solution
more disruption than a pipeline
Interfering with the environment will be a never ending waste of time, resources and money, which can be better directed by the Government into more productive areas such as Hospitals, Roads and Schools.
Less environmental impact and infrastructure requirements
Heavy machinery on a public area. What could possibly go wrong!!!
This option is currently the status quo and it has been unsuccessful at building up sand at West Beach. It has caused great alarm to beach users along the coast because it is dangerous, noisy, polluting and intrusive.
It is destroying as well as lowering beaches at Semaphore and Largs Bay.
No trucks on beaches
Very disruptive to beach users and native birdlife
As much as I find the trucks really unpleasant on the beach, this is my overall preference.
Only support if 100% from quarry
For stopgap measures and fixing hotspots, yes. For prolonged and ongoing measures, I believe it would be cost prohibitive, not to mention the ongoing safety concerns that arise from large transport on the beaches
Solving one problem, creating others. Trucking is high cost, environmentally unfriendly and creates more traffic on our somewhat congested roads.
Only as a temporary measure
Not remotely economical and puts too much pressure on road infrastructure.

This does not work, as has been proved by years of poor management. Also very expensive. Why not look to ideas from other countries, where they also have similar issues with drift.
Do not want any harvesting or trucking sand from beaches! Do not "rob Peter to pay Paul" - again! Every beach is important! Do NOT try to pit different groups against each other!
Adelaide beaches and their dune systems are the frontline defence against the impacts of climate change and we must all work together!
This has been disruptive and dangerous on the beaches for many years. The moved sand has been unsuitable and continues to erode a a faster rate than than is deposited. A short sighted, short term continuous action which has failed to prevent erosion of out beaches
Negative impact to beach users
This is not a solution, least effective band aid
Least impact on marine environment
This 'basecase' option is a return to the status quo and it has been unsuccessful at building up sand at West Beach prior to 2023. It has caused great alarm to beach users along the coast because it is dangerous, noisy, polluting and intrusive.
It is lowering beaches at Semaphore and Largs Bay.
There needs to be a process involved to compact the sand once it arrives at West Beach. Otherwise, it will just be "swept" away continuously. This isn't a long term, ethical, sustainable solution. It would have irreversible impacts on the planet. Unless these are hydrogen powered / e vehicles, I am very against this option.. Military road and barcoo road are also not designed for heavy vehicle access, there are so many cyclists and runners in the area - creating a significant safety concern.
No sand should be mined or trucked from any beach. The temporary use of quarry sand as a last resort at times of need to supplement other measures only has reserved support. No new evidence has been presented to support a pipeline and/or the use of beach sand as a nourishment source. The community has not been widely informed of the full impacts of any of the shortlisted options, despite the opportunity to complete this survey. How many jetty users for instance would be aware that they risk having no jetty access for 4 months of the year? Our community has experienced several years of sand mining and trucking and can not continue to tolerate the disruption and damage this causes particularly as there are few perceived benefits of using this sand to fix problems elsewhere. Options 2.1, 2.2, 2.3 and 3 do not represent value for money and do not adequately meet the 3 review criteria from the point of view of the community. No full assessment of the damage already sustained by the northern beaches and dune system has been undertaken. Continuing the same practices hoping for a different outcome does not seem scientific and will not meet community approval or acceptance.
This is not a sustainable solution
Do not support trucking sand
This is what is required to catch up due to the governments continual delay and excessive reviews.
Archaic, backward and unimaginative.

loud messy and not sure about quality/ impurities if sand
disruption and costly
Not using natural resources
Too far to truck sand from Semaphore to West Beach.
As per previous answers
Would erode the beaches here quicker
You need to think long term if you keep taking sand from any beaches all of them will be gone soon. Look at using gabions (cages with rocks at back nicer large smooth rocks at front to shore up existing eroded sand dunes, fill behind with coarse sand from inland if necessary & plant up with dune binding plants.
Then source inland sand on trucks to somewhere up coast where it won't impact beaches & load onto boat that can distribute this sand along the coast on top of existing sand & no need for dredging?
This should be the absolute minimum efforts
Why not use the pipeline which will minimise the use of trucks as there is already a pipeline installed. Makes sense to me to use that and the trucks therefore minimising excess trucks.
This would be absolute minimum requirement
Unclear which beaches the sand would be sourced from
Clearly this option returns to the past difficulties of sand management with machinery on beaches and roads, causing safety issues, road damage and traffic congestion.
The option requires the movement of sand using diesel as the fuel, rather than pumping sand with electricity.
I gather from comments in the first survey that this method does not work very well in maintaining sand levels at West Beach. Collecting sand directly from the beach is disruptive to beach users and this happening for 4-6 months over a year is too long given this disruption.
100% quarrry sand no beach sand
Pollution
As a temporary solution until permanent pumping of sand is established.
Only support if using 100% quarry sand (no beach sand)
This would cause irreversible environmental damage for beaches you are taking sand from - these beaches have still not recovered from having trucks on them previously.
This also renders the beaches with trucks on them
Unusable for northern residents during these periods and would have a devastating impact on local businesses.
This option can not go ahead!!!

Keep trucks off northern beaches!!
This would destroy Semaphore and Largs Bay beaches environmentally, socially and financially.
This option MUST NOT proceed!
trucks are disruptive
Doesn't disturb seabec
This option moves sand from north to south and does not involve damage to the sea bed. Trucks at certain times of the year have worked well in the past.
only support if 100% quarry sand--no beach sand
as long as iyit is trucking from the northern beaches
temporary fix, not a solution to the problem
Hard to tell. Would only want quarry sand and no beach beach sand relocated.
Only support this option if there is NO BEACH Sand trucked. Only support if ONLY QUARRY SAND IS USED
Supported but caution as to whether this is a long term sustainable solution for the amount that would be required
Does not damage the marine ecosystem
why take sand from the beaches? when all the beaches are being affected by erosion
same as before
Same as before, the impact on the beeches would be quite high and will also cause problems with usage of our costal area.
Strongly oppose trucks on the beach
This is what they did at Largs and Semaphore recently. It was very disruptive to beach users and the beach at Semaphore looked terrible for a long time. It is also unsafe to have trucks on the beach
Worked well in the past as far as I know
Not sure quarry sand should be introduced. Trucking and sand carting is a long standing grumble and disturbance to local beachgoers
Damaging, disruptive, inadequate
None of the options are attractive but this option will not irreparably affect marine life. I prefer this to pipeline options.
This is so disruptive to beach goers. It is expensive and not a permanent solution
This option is currently working OK for West Beach, but has 3 significant downsides. It leads to a continued build up of sand in the northern area, there is no solution for Henley Beach South as there is no access for the sand lorries except during a very short period in the year when the Torrens is low and the Plovers are not breeding, and there are major noise and environmental pollution effects for local residents living at any point on the delivery route for any sand moved from the North.

Support only if 100% quarry sand (no beach sand)
trucks on the beach tends to upset beach users
This has not worked in the past it just erodes and disrupts the beaches from where the sand is being mined. I do not support any machinery or infrastructure that disrupts the beach or puts the dunes at risk. I have seen over the past 3 years particularly, how the mining of sand causes erosion into the dunes. Some of our beach access points become unusable as the step to the lowered beach becomes a sand cliff. Very dangerous and I have personally been impacted by this.
Truck pollution
This has less impact on the beaches
no impact on existing community
I would prefer to limit the usage of trucks and machinery where possible hence I would rather the pipeline be built but if it were between this option and any option involving dredging I would pick this.
Better than other options but expensive and continual disruptions
Very disruptive to all beach users
As above, impact n environment, community and businesses having trucks up and down the beach
Not the right solution
Trucks do not belong on beaches. Sandcarting has already caused damage and erosion to our dunes. We do not have a biild-up of sand on Semaphore and Largs Beaches. To the contrary we've lost sand.
Further, trucks pose a danger to humans, including children, and dogs.
Only a Band-Aid solution to the issue need infrastructure in place to return lateral drifting sand
Huge disruption and destruction of our beaches making them unusable for periods of time or dangerous to use. Moving vehicles and noise affecting beach goers and wildlife. Dangerous ruts in the sand which are sometimes unseen when under water.
Enviromental impact from trucks on beaches wildlife, people and businesses
I an emergency this can be an option
Would only support this option if the carted sand was 100% quarry sand. The northern beaches should not be dug up and damaged for the sake of residents in southern suburbs. We in the north have beaches that are in need of protection and appreciation. They provide valuable habitat, as well as amenity to those of us who live in the north.
The quarry sand is likely in the future to be way too expensive as it is already 10x the cost of sand on the beach, but recycling sand from the north makes sense. The recycling of sand is the answer for long term, cost and environmentally effective. We still need a mass fill to maintain a 1970 base level. This should use minimum truck movement using northern sand.

Not a viable long term solution as there is a limited supply of suitable sand. The cost is also very high.
No quarry sand
All beaches north of the Torrens are eroding. No point in taking sand from them in the face of climate change. The other option is to use quarry sand which is the normal way of sourcing sand for engineering projects.
Disruption, expensive
Truck on beach are a risk to people and it's not a long term solution.
Will destroy fauna and flora and make beach unusable at times.
Do not like the idea of using trucks to manage sand cartage as it seems as an inefficient and environmentally unsound way to manage this task and very expensive
Do not support trucking sand.
There is a better option that is so obvious to anyone who has any knowledge/experience with our beaches. It's NOT rocket science.
Will only consider support if 100% quarry sand is used
This option requires trucks and heavy machinery on beaches for 20 years. Placing sand on the beach face steepens the beach face causing the sand to erode more quickly. It is an expensive option that has a low rate of success of maximizing sand staying on beaches. It is highly disruptive to communities and has a high degree of green-house gas emission.
Significant impact on beach residents, users and general amenity
Only if 100% quarry sand
Quarry sand is too expensive
Recycling sand is the best way
Still just shifting the problem across other areas ... and can't be micro managed as easily ... and would work out dearer in the long term .. with regard to deliverability, environmental carnage, a greater political / community dividerer / interferer ... with greater encroachment onto the roadways and still limited sand source ... with some inevitable environmental marine decimation still likely.
Continual movement of trucks on beach detrimental to local fauna
This is the worst of all.
Again, trucks and machinery on the beaches is a bad option
Again, using quarry sand is one of the worst ideas.
I strongly do not support trucking sand from Semaphore or Largs beaches. Trucking sand from quarries is OK.
.
No pipeline solution

Keep trucks off the beach
I don't like trucks on the beach. They are hazardous and compress the sand understructure. They also restrict people's and dogs' access and enjoyment of the beach. I question the futility and ongoing expense of trying to intervene in a natural, dynamic system of Northerly sand drift. Houses at West Beach, Tennyson, Brighton and Somerton should never have been built on the sand dunes.
Trucks on the beach are a no go. Quarry sand may not be the correct type of sand.
Preferred way, Elysee impact on Sea life
Don't disagree as much as the pipeline. BUT the carbon emissions and air pollution impact of carting the sand needs to be considered. If the dredge out of west beach solves the issue at half the price why is that not the best option?
Environmentally unfriendly and very unfriendly to beach users, excavators and trucks on the beach.
Potential hazards of large trucks around beach users
Simple and effective. Can be scaled as necessary, provides work for truck drivers and generally happens in winter months when beaches are less busy,
too disruptive
No trucks on our beaches. Leave the beach sand alone. Trucks on beaches destroys the delicate beach habitat and makes the beach unavailable to community members for months at at time.
Trucks also threaten and destroy the delicate dunes. We have hard evidence of this. By taking sand off northern beaches, you in effect raise the sea level each time by the amount of sand taken. The sand on our beaches is reducing. It is a myth that the sand on our beaches has drifted in from West Beach. That is not true. It settles off shore. It might appear that there is more sand in the northern beaches but it is disappearing faster each year due to increases storm activity. Those dunes support a delicate biodiverse environment of flora and fauna. This option involves trucks on beaches and lack of access for beach users as well as potential danger of huge machines and trucks on the beaches not to mention the destruction of a beach.
The only way to support this option is IF ALL the sand is quarry sand.
No trucks on beaches or roads
too harmful and disruptive - see previous comments.
Environmental impact, beach disruption, cost
Trucking has traditionally been the least costly and most flexible means of redistributing sand on Adelaide's beaches. But it has been extremely unpopular, adds to road traffic (and danger when trucks move along beaches) and is fossil fuel intensive. I have already commented on trucking washed sand from onshore quarries - as a possible last resort.
Traffic interactions along the local roads, wear and tear on already stressed roads.
Traffic interactions on the beach with beach users
Balance between user impact and cost is better

I don't think quarry sand should be used. This finite resource needs to be used elsewhere and impacts threatened land based ecosystems.
Do not support metro beach mining
Waste of time
Only support if 100% quarry sand (no beach sand)
No to any kind of sand removal, carting or trucking on the beach. Only supported if sand is collected from quarries not the beach
To disruptive to the locals affected by the work scope
Poor carbon footprint, disruptive to community, damage to foreshore and beaches while mining sand
Most disruptive.
The excavation and collection of sand from Semaphore and Largs Bay beaches by trucks has been detrimental to the beaches and the local residents for many years now, it is no longer a viable option. The only benefit seems to be to the trucking companies that are making money from this ongoing fruitless effort.
Should be supported for mass re fill only if is no sand pipeline to recycle the sand back to where the northward begins at West Beach. It is an extremely costly method without recycling the sand. Quarry sand is far too expensive as an ongoing option. Also means the disruption by the trucks delivering the sand would be ongoing on both the roads and the beach.
This isn't working, shouldn't even continue to be a permanent option. This is only appropriate for a short time until and better/ permanent option is completed. The trucks block parts of the beach for both areas (where the sand is excavated & delivered), restricting use by locals & visitors of our beautiful beaches.
Absoutely not as there would be trucks and heavy machinery on the beach as well as up and down the streets.
From past experience, this precludes me from walking on the beach with my dog as it is just not safe. If I had small children I would think this would be highly dangerous...not to mention the mess it makes of the beach and the loss of dunes during winter storm.
Terrible idea , hugely disruptive, environmentally unsound and utterly inefficient
This only supported as last resort.
Backup position
I do not support the taking of any sand from Semaphore and Largs Bay and other beaches and carting it to West Beach or other beaches as it is not sustainable in any way. Far too disruptive for the community, destroying one part of the coastline to try to help another part isn't the right way to do it. Studies have shown it isn't going to work with Semaphore and Largs Bay sand as it is too fine, and that these beaches are already losing sand as it is, and haven't recovered from the last time and was carted away (2022 DEA CSIRO satellite imagery). When the carting was underway a few years

ago it was so depressing to see that I had to stop my 5-times-a-week morning beach walk for about 6 months because I hated seeing the damage to the dunes and the sadness amongst the community. There are better options, such as if all the sand needed at West Beach was taken from quarries.
It is not going to be sustainable to take sand from beaches such as Semaphore and Largs Bay. They cannot cope with the sand loss even after one year of carting, with terrible dune loss already. Destroying coastal habitat for birds - some protected species too - and ruining the aesthetics as well as function of the beach for visitors and for locals. The increased storm activity with climate change means sand carting will ruin the northern beaches and not even properly address the need to help West Beach. Options 1.1, 1.2 and 1.3 look to be much less environmentally, socially and economically damaging overall than carting, and look to be more likely to actually produce a better outcome for West Beach and surrounds than Option 3 carting as well.
Again, aside from noise, pollution by the machinery, the work that is done over months/years/ millions of dollars can be wiped out overnight by another 'perfect storm' of conditions (as occurred seven years ago. We do not want trucks or heavy machinery on our beaches. At all.
High environmental impact to sand dunes flora fauna and disruptive to communities, noise pollution...how can people feel safe and enjoy time on beaches when there is noisy moving heavy machinery there
My overall preference is NOT to Dredge OR use a Pipeline - both are reactive solutions to the problem. My overall preference is to address the root cause of the issue (Climate change, Increasing Storms and Wave Movement) and create an artificial reef or breakwater ~1km offshore. Addressing the cause, not the symptoms is my strong preference.
Nevertheless, I have selected "STRONGLY DO NOT SUPPORT" as this option requires trucks and heavy machinery on beaches for 20 years. Placing sand on the beach face steepens the beach face causing the sand to erode more quickly. It is an expensive option that has a low rate of success of maximizing sand staying on beaches. It is highly disruptive to communites and has a high degree of green-house gas emission.
This is business as usual. It works if implemented in timely manners as mostly the CPB has been able to do. In the meantime, more science and data can be done, more overseas and interstate experiments in sand management can be investigated. I feel the pipeline locks SA into a once-only, one thing solution. Nature is not like that. A mixture of approaches, including growing seagrass meadows, the complementary dune revegetation and growing with fences, working with nature will all be needed. More emphasis on the wholistic nature of the challenge would be helpful when you announce your approach.
Trucking is undesirable for reasons of community inconvenience and public safety. Trucking from quarries is not as bad as trucking from another beach. Trucking from quarries could be used in exceptional circumstances (emergency relief, etc) but should not be the norm.
Having experienced this type of sand carting on semaphore beaches i most strongly object to heavy machinery on the beaches on social environmental and safety basis Also note higher estimated cost than dredging proposals without considering social and environmental costs

This options requires trucks and heavy machinery on beaches for 20 years. Placing sand on the beach face steepens the beach face causing the sand to erode more quickly. It is an expensive option that has a low rate of success of maximizing sand staying on beaches. It is highly disruptive to communites and has a high degree of green-house gas emission.
This option is supported as a option of last resort only. It results in the significant disruption to both northern and southern communities. The proposed volumes of sand nourishment will not result in the re-establishment of the beach profile on the southern beaches and there is no upfront mass nourishment proposed. This option uses old, high carbon footprint and unsustainable technology and has been proven not to work in this location.
Potential benefits
Results in some (inadequate) sand nourishment on southern beaches
Potential risks
Inappropriate disturbance and reduced beach amenity for our communities as a result of heavy vehicle movements
Impacts associated with reduced amenity, noise, pollution, inaccessibility, environmental harm
Sea level rise in the future and increased storm events and intensity would render this option unsustainable in the long term
Not permanent and not proven to work
Old technology and high carbon footprint
Results in the significant removal of quarry material which is unsustainable long term
This is the worst option. Again, taking sand from an eroding beach while putting beach users at risk makes this ridiculously expensive and dangerous.
I would only support if 100% quarry sand. i.e. no beach sand
Out of all the options, this is the best out forward HOWEVER it is not a long term fix. NONE of these options are long term fixes
This could be supported if it was only quarry sand. Stop destroying Semaphore and Largs to prop up other beaches
I would hate to see the trucks back on our beaches destroying the dunes again. They have not recovered from the last sand carting event.
Environmental damage from use of trucks
Nuisance impact of trucks
Degrades existing beaches
Quarry sand is a finite resource and using it restores one environment at the expense of another
Yes as a temporary solution until the actual solution has been agreed upon and put in place
No trucks. there is already enough sand on the northern beaches, why access the quarries its completely ridiculous

The right kind of quarry sand or desert sand only.
No beach sand from one beach to another.
Is this really financially viable, when this has not given the respite required thus far. Keep doing what you are doing and you will get the same results.....nothing.
Seems to be the option that has the least number of variables and can be implemented the quickest. Can also give West Beach an initial mass fill.
It hasn't been working previously. Why waste our tax dollars on this method. Sand diameter is important so collecting from the beach where it is too fine is useless.
There is no benefit to disrupting the beach amenity.
See previous answer
This options requires trucks and heavy machinery on beaches for 20 years. Placing sand on the beach face steepens the beach face causing the sand to erode more quickly. It is an expensive option that has a low rate of success of maximizing sand staying on beaches. It is highly disruptive to communites and has a high degree of green-house gas emission.
This would be a desirable option if the majority of sand was sourced from quarries.
Support this option but only as a last resort. The central beaches need sand. This option would only maintain at current levels rather than provide the mass replenishment that is required to restore these beaches. So at best, this is merely a "better than nothing" option. So provide luke-warm suppport but hope a sustainable long-term option is provided.
Only support this option if 100% quarry sand- NO BEACH SAND
I do not support this as a strategy to help out beaches losing sand - that should be sourced elsewhere. However if a beach has a build up of sand that is becoming intrusive eg. covering the jetty, then there could be a need to collect and truck that sand elsewhere. That would be handled on a "need to act" basis, not set in stone as a regular occurence.
current practice is working ok
Do not agree with using quarry sand which will just migrate to northern beaches.
Better than any option involving dredging but I anticipate the next option will be better.
This is fine for marine life.
Yes but at the whim of Government. Only have trucks on one beach.
We need sand now. This is better than nothing.....
As above- I am opposed to any trucking of sand from onshore beaches. We can see the destruction at Semaphore beaches due to this practice and environmental advice is that an increase in big storms will further increase erosion.
I would only support this option if 100% quarry sand is used. I am opposed to trucks on beaches. They damage the fragile beach environment and are noisy and dangerous. Our beaches are used all year round and trucks have a huge impact on the local community.

Too disruptive too beach and coastline and beach goers
From a quarry maybe but STOP TOUCHING SAND FROM THE BEACH. WHY WHY WHY?
Sand is being moved from high area to low area and allowing the offshore sand and sea grass to stabilise.
Hopefully all only temporary as the seabed establishes the seagrass
Taking sand from other beaches should be avoided at all costs, but taking sand from quarries might be suitable. Semaphore and Largs don't have enough sand as it is to re build West Beach. The quarry sand would stay at West Beach longer and wouldn't ruin one beach in order to prop up another. Trucks and machinery on beaches is very unpleasant but it is more so about the negative impact it causes for the community and tourists ad local businesses in not being able to enjoy the beach as they see the damage to the dunes, birds, habitat and worry about safety and loss of beach size, even more so than it is about actually seeing the trucks and machinery (which are of course ugly, loud and inconvenient).
There must be someone in your office that hates beaches.
Leave the beaches alone, they struggle as it is.
Ugly, disruptive and noisy for those of us who use the beach most.
Maintains large numbers of trucks at West beach
It has been the method before but it really makes a mess of the beaches.
Will get complaints from locals on noise. What about road infrastructure damage etc
Same as 1.3
Are you kidding?
Has vehicles on beaches for long periods on an ongoing basis.
No taking sand from beach
Both the beach from which the sand is harvested and the beach to receive the sand would become unusable.
A woman who lives next to where the trucks enter the beach with quarry sand told me that at its worst, she has one truck per minute, going past her place. She and her family no longer sit on their balcony to look at the sea. Every three days she sweeps up a dustpan full of black dust from the balcony.
Trucks belong on Grand Junction Road, not on our beaches and neighbourhood streets.
No -one wants trucks, pumping stations, tractors, sand dredges, excavators, trucks parked overnight, noise and disruption on our beaches or in front of our houses and businesses. if this happens, beachgoers will go to calm quiet safe beaches.
Against sand carting trucks on our beaches, so only support if 100% quarry sand and truck movements well managed.

This is not a viable, long term option due to the pollution associated with this strategy and the impact it has on local communities. The environmental impact on beaches and dunes through sand excavation and trucks on beaches during collection will be catastrophic.
I do support quarry sand delivery as a short term, top up measure in 'hot spots' or in emergency situations where sand is needed to prevent damage to infrastructure or there is a public safety issue. eg. at Henley Beach right now.
Whilst this option is intrusive, in the absence of the implementation of a solution, this is better than doing nothing.
Only if sand from quarry. Not beach sand
Saw the damage to dunes dune face beach & intertidal zone previous times. These haven't recovered.
The sand is too fine, it is a major disruption to Northern beaches, there are major negative environmental impacts. There is not one positive thing about the pipeline apart from taking trucks off of West Beach! West Beach is not a major attraction point, with no jetty, main strip, or community grassed areas - unlike Semaphore beach. Semaphore is a major/popular beach, attraction, and meeting location for many families and communities of the Western and Northern suburbs. Semaphore holds decades of history and is well loved by many in Adelaide. Having trucks, sand carting, or a jetty closed will stop many from continuing with their daily recreational and calming activities like walking, fishing, meditating, running, bike riding, and so many more. I don't understand why you would want to ruin a very popular, major beach to save a beach with no major history, recreational activities, or popularity to SA. I urge you to perform a survey of those that attend Semaphore vs West Beach throughout the year... this may cause you to rethink this decision.
1. Any sand taken from Semaphore, Largs and Taperoo beaches is not being 'replaced' at a reasonable rate. There does not seem to have been any consideration of replacing sand on these beaches when they have been ruined.
2. Again, this option requires trucks on the beaches permanently. This is unacceptable.
Environmental disruption and amenity disruption from beach excavating.
Only support if completely used external quarry sand, not sand from other beaches as that will completely ruin Semaphore - it is already losing beachline and the increased storm activity and rising sea level means it needs to keep all the sand it has, plus actually get more back to recover from the round round of sand mining! For both environmental (dunes, wildlife, beach quality etc) and social/community reasons (safety, aesthetics, visitation, quality etc.), it is simply not an option to take sand from beaches.
Again, the mess they leave the beach in is a safety concern, we walk the beach all year round
ONLY support IF 100% quarry sand (No beach sand).
Otherwise Do Not Support.
No to trucks on beaches

Expensive, disruptive to coastal communities and beach amenity due to trucks and large equipment on beaches. Unsustainable.
Trucks - I already know how trucks on our beaches spoiled the use of our superb recreational asset, when that was happening at Semaphore South, Semaphore and Largs. Too noisy for quiet enjoyment, were viewed as unsafe for seniors, children and dogs amongst other beach users, left deep tyre ruts which hindered beach use ……
this is an awful option for northern beach users and residents. These are very large mining trucks which remove layers of sand, damage the dunes which will protect the shore and are scary when you are walking on the beach
I don't support carting as it lowers some beaches which is putting their protective dune system at risk and maintains trucks and tractors being on beaches. Climate change will ensure sea level rise and taking from one beach to replenish another is very short term planning.
Previous sand carting campaigns have shown how destructive they are to the source beaches and dunes. Trucks on beaches are disruptive to communities. Sand doesn't stay on the beach - this is a failed option. Sand must be deposited off shore and leave wave action to build up the destination beach.
If none of the dredging or 'dredging plus quarry sand' options proves feasible, I would support the trucking of QUARRY SAND ONLY to the beaches most affected by erosion. For reasons given earlier, I cannot support the further depletion of sand from the northern beaches or the use of heavy machinery on the beaches. Furthermore, this option 3 is financially expensive compared with options 1.1, 1.2 and 1.3.
Trucking should NOT mean trucking sand dug up from beaches
Sand Carting (status quo)
The same long-term impacts of a pipeline apply here.
1. HARMFUL AND DEVASTING IMPACTS TO OUR COMMUNITY. THREATENS THE FOLLOWING -
a) Loss of tourism, loss of community space, loss of community well-being due to invasive and destructive annual practice of quarrying sand from beach or near shore areas.
b) Negative Impact to local businesses of Semaphore and Largs Bay during winter when business is marginal at best (i.e., role of beach, dunes and foreshore in visitor economy and supporting local business activity)
c) Damages the role of the Northern coasts in identity of place (i.e., activation of beach and community activities in dunes and foreshore)
d) Loss of Public safety (i.e., truck movements on beaches at 40kph equal to Semaphore Road, excavations on beach and intertidal zone);
e) Loss of Public amenity (i.e., noise, truck speed, beach closures and nuisance impacts)

f) Detrimental to Natural environment and increase in coastal erosion (the removal of sand from the beach and tide zone creates a relative sea level rise by localized lowering of beach, storm surges then destroy dunes because the ocean can reach them).
g) Accelerates threats to local infrastructure by destroying our first line of defence from storm surges – beach and dunes
h) Loss of beach/jetties access for sports, leisure, and mental health
i) Accelerated coastline loss, dune recession and destruction
j) Impacts to flora and fauna (environment)
k) Increased Noise and air pollution from trucks, pumps, excavators
l) Works against nature, invasive, destructive
m) High capital costs that impact community as taxpayers
n). Not flexible, meaning the damage will be unsustainable to Northern beaches and ongoing until project failure. Internal sand has proven ineffective in maintaining and sustaining West Beach. And there is no modern evidence that Northern beaches are receiving sand from West Beach, in fact the coastline is now eroding.
The sands from the southern beaches are NOT accumulating on the shore at the northern beaches. The northern beaches are also receding. Trucking sand from beaches has already made a negative impact on the shore and the dunes at Largs and Semaphore.
Only support trucking if 100% quarry sand is used. Removing beach sand has created a new problem on the northern beaches.
The carting option, that has been used for the last decades, is not sustainable in any way as the cost is huge, the results limited and the environmental and social impact significant when trucks are taking and transporting sand for months all along the coast.
A crude solution
Short term costly and a huge impact on roads and local residents
If this has to be it has to be. Not the best carbon footprint, (,just like dredging in that respect)
This has worked for at least the last 50 years.
A mass nourishment should be added into the northern beaches.
If dredging or dredging plus quarry sand options prove unfeasible, I would
support the trucking of QUARRY SAND ONLY to the beaches most affected by erosion.
This option is also more expensive than 1.1, 1.2 and 1.3.
Only support if sand comes from quarry source only, NOT from Largs or other nearby beaches.
Noisy and disruptive. Shortermist

Ecologically this is a suitable solution, but the use of machinery along the beaches is not best practice as it introduces public safety issues and possibly will create out of hours noise for local residents
Trucks on beaches, expensive, and ineffective
See previous answer
massive damage to the environment
Trucks and heavy machinery making the beaches unsafe and unusable for 20 years - NO thank you, we have had enough of this already. And we did have endangered migratory sea birds calling our beaches home - not any more. A bird the size of a small mouse nesting in the sand above high water mark is no match for huge trucks belting up and down the beach for month and months. Not acceptable any longer. Not sustainable, not economical.
Only support if 100% QUARRY SAND. NO BEACH SAND!!!!
Only as an option of last resort if options 2.1 and 2.3 are not available
- DOES NOT TAKE TRUCKS OF BEACHES if planning to use Semaphore/Largs Bay beach sand
- Potentially support if 100% quarry sand
Sand Carting (status quo)
The same long-term impacts of a pipeline apply here.
1. HARMFUL AND DEVASTING IMPACTS TO OUR COMMUNITY. THREATENS THE FOLLOWING -
a) Loss of tourism, loss of community space, loss of community well-being due to invasive and destructive annual practice of quarrying sand from beach or near shore areas.
b) Negative Impact to local businesses of Semaphore and Largs Bay during winter when business is marginal at best (i.e., role of beach, dunes and foreshore in visitor economy and supporting local business activity)
c) Damages the role of the Northern coasts in identity of place (i.e., activation of beach and community activities in dunes and foreshore)
d) Loss of Public safety (i.e., truck movements on beaches at 40kph equal to Semaphore Road, excavations on beach and intertidal zone);
e) Loss of Public amenity (i.e., noise, truck speed, beach closures and nuisance impacts)
f) Detrimental to Natural environment and increase in coastal erosion (the removal of sand from the beach and tide zone creates a relative sea level rise by localized lowering of beach, storm surges then destroy dunes because the ocean can reach them).
g) Accelerates threats to local infrastructure by destroying our first line of defence from storm surges – beach and dunes
h) Loss of beach/jetties access for sports, leisure, and mental health
i) Accelerated coastline loss, dune recession and destruction
j) Impacts to flora and fauna (environment)

k) Increased Noise and air pollution from trucks, pumps, excavators
l) Works against nature, invasive, destructive
m) High capital costs that impact community as taxpayers
n) Not flexible meaning the damage will be unsustainable, Internal sand has proven ineffective in maintaining and sustaining West Beach. We must seek external sand.
Carting will only be a viable option if quarry sand was to be used. Beach sand is not suitable and I strongly do not support the carting of beach sand. This is also an expensive option for tax payers.
Trucks on beaches are a disruption to the beach users
Don't generally support trucks on beaches but realise that it is needed to replenish eroded beaches in the short term
As I said I do not support any trucks or infrastructure on the beaches.
Only as a last option. We have endured trucks on beaches and their disruption for too long
involves trucks on beaches - most disruptive to the public
This options requires trucks and heavy machinery on beaches for 20 years. Placing sand on the beach face steepens the beach face causing the sand to erode more quickly. It is an expensive option that has a low rate of success of maximizing sand staying on beaches. It is highly disruptive to communites and has a high degree of green-house gas emission.
No excavation on beaches
As a last resort
Better than dredging
creating permanent infrastructure protects our beaches from future de-funding
100% quarry sand may be OK but again this option turns the landscape into trucking central.
permanent infrastructure needs to be developed to protect the beach management from future de-funding
I support this as west beach need's a government to do something. Would happen sooner than other options.
Allows for recycling of accrued sand from the northern beaches. The jetties of grange semaphore and Largs are nearly landlocked as an indicator of the volumes of sand accruing to the north.
Affects west beach more than the northern beaches so doesn't share the load equitably across the coast as a whole.
Greater disruption for our access to beach at both ends and transport routes from north to south.
Will quarry sources have future issues with disruption due to local impacts to their communities? Shifting a problem that doesn't need to exist
Excavating Semaphore and Largs Bay is not supported as mentioned previously.

Long term Collection of quarry sand and delivery to West Beach is disruptive to West Beach communities -so not supported. Emergency delivery of quarry sand or use for management of" hot spots" such as at Henley Beach, Henley Beach South and Semaphore Park is supported, as necessary
only support if 100% quarry sand
This seems to be the solution that has been in place for a number of years and has not worked.
Do not support, but only as a last option if pipeline is deemed a no go.
As stated above, disruption to beach use, no micrograms in sand, . Environmental damage due to heavy vehicle use and trucking large volumes of sand long distances.
No recycling of existing resources, the sand has built up north, it should be recycled.
Trucks on ‘ all beaches, north and south to correctly and fairly manage.
Because of information I have read from Save Our Shores (SOS)
living at West Beach, I'm sick of the trucks
It is CLEAR the community cannot withstand more trucks on beaches. I have been on the beach when there have been trucks and it was a very disheartening and upsetting experience. I felt out of touch with a place that brings much healing and peace. Having this heavy machinery breaks this peace and I felt unsafe for many reasons. I felt like I was on a road and the places in which sand is dumped is consistently poor. It is often placed in walkways and I constantly see it blow onto roads. This sand DOES NOT stay on beaches. Trap the sand somehow. Weigh it down. Trucking sand destroys community and reduces health outcomes. I know this from personal experience and from years and years of community expression. Please listen to the community. Beaches are so iconic to Adelaide. Not just for commercial / financial benefit, but of course MOST IMPORTANTLY for peoples health, joy and community.
Do not destroy northern beaches to fix West Beach.
Very disruptive to beach visitors.
I do support trucks being used to deliver quarry sand.
I understand this to be the business-as-usual base case. I do not support this option as it requires trucks to be travelling on the beach between the Henley Sailing Club ramp and the Henley jetty for several months annually of everywhere. This destroys the amenity of the beach during these times and has a negative environmental impact on the foraging habitat of the Hooded Plovers and the Red-capped Plovers. The pipeline option does away with the necessity for this option.
Worst idea ever. Waste of money when there’s sand already on the coastline they can be used.
Only if 100% quarry sand
Same as it is now.
Machinery on the beach
Part of this is ok. Using Quarry sand. Much coarser than beach sand, so the sand would be heavier slowing the process down. Where will you get the sand from???? Not local beaches. How about

learning where the sand really goes. Find the massive moving sand dune that is swallowing up people's farming land. Burried deep underneath is now an old heritage caravan park, that no-one has seen for over 30 years. Still with vans on-site, but burried under the MASSIVE MOVING SAND DUNE. Which in fact; you created.
Only support for quarry sand. Not beach sand.
Disruption to beach users

Do you have any other feedback?

The sand collection on Glenelg Beach was RUINED this year by ineptitude.....
Sea grass and or groynes should be considered.
no
Be mindful of extra costs involved for ongoing maintenance and upkeep of piplines for government (has this been considered). Assuming dredging would be contracted out costs for ongoing maintenance etc would be at their costs.
Any pipeline used hopefully would not distract from the view beautification of beaches, for beachgoers and residents.
Something needs to be done about the huge deposits of rotting seaweed on the northern end of Taperoo beach. It smells and provides cover for brown snakes which are an increasing hazard in the area.
I strongly appreciate the effort to review these options. I think the options that balances the least amount of cost, least amount of permanent infrastructure, and no beach interference has to be the option that is explored further to ensure there are no unwanted consequences.
I do not in any way support digging of the remnant dunes to install a pipe. If a pipe option returns to being a preferred model, it has to do so with minimising dune disruption as its mantra.
Where is the Science in these options, who did what scientific analysis??
Given the many reviews and this wasted time and effort it seems bizarre that the new State Government has not got on with building a pipeline.
Also why has no reference been made in any of the options to the successful sand pipeline to Seacliff/Kingston Park?? Doesn't the Government want to mention the most obvious and successful approach already in place just to the south??
The Adelaide beaches were created by natural processes. Humans should not have built so close to the sea. Let Nature take its course. If sand dunes erode then that is what is supposed to happen geologically. My view as a geologist is that the coast is accreting not degenerating. You are wasting resources which could be put to better use.
What research has been done to restore the beach water interface back to pre colonisation?

What were the natural environment systems operating and how did they control the sand movement?
from a quick search I have selected the following:
- Sea grass leaves slow the flow of water, causing sediment and other suspended particles to settle quickly. Sea grass roots also stabilize ocean sediments. This ecological service improves water clarity and reduces coastal erosion.
- Seagrasses can create or significantly modify their environment and provide microhabitats that would not otherwise exist. For example, they take in carbon dioxide—improving chemical conditions for species affected by ocean acidification—and release oxygen
- Healthy seagrass meadows are a nature-based solution to many threats facing coastal waters and communities, including climate change.
So why isnt (or is it) the SA Government growing vast beds of sea grass and preventing sediment and pollutants entering the coastal areas????
No
I am dismayed that every single option will further damage beaches. It is astonishing that not a single short-listed option has the potential to improve coastal management.
Better than the previous survey
Get on with it!! No more studies. Why can't we be trucking sand back south while you are working out what to do!
Built the pipeline please, do it once do it right. Please think about future generations of all South aussies
We live where we do in order to be able to walk the dog on the beach every day. Sand carting severely constrains our enjoyment of "our" beach, and so has a negative impact on our quality of life.
Prefer maintaining current status - pipeline sand only.
Sand is the best protection to our infrastructure of the coastline and I believe the pipeline once in will last longer than 20 years and be the most likely to be used by whichever government is in.As technology improves it will be easier to adapt to this infrastructure
You need to hurry up as the longer it takes the more it will cost. No more delays get cracking.
It's pretty basic really. If we want beaches we have to manage the northward sand drift. Recycle the sand from northern to southern beaches using pipeline slurry. Many northern beach residents see this as theft of "their" sand. In the sixty years I have been a regular beach goer there has been a huge accumulation of sand from Semaphore north. Northern beach residents may think this is great now, but what about in 20 years when your jetties are high and dry and you have to walk a kilometer from the Esplanade to get to the water for a swim!? Recycle the sand in a way that minimises disruption and nuisance ... otherwise we'll all lose regardless of where we live.
No
Yes I have some feedback.

Engage a proven hydrology University or Consultancy to design Breakwaters, Artificial Islands and Groynes to modify coastal drift .
The Semaphore bower Rd breakwater appears to be effective in sand control even after storm events, contrary to the submitted methods which are listed here.
The high carbon and monetarily intensive sand carting is an irresponsible approach ,and not at all a permanent solution.
One week end of storm activity would wash away millions of dollars worth of human sand shifting.
The Dutch are renowned in tidal coastal modification to prevent and even reverse sea front erosion.
I suggest engaging with one of their Universities with proven expertise in this field
There have been many reports over 30 years all recommending the pipeline system. This process is perpetuating fee payments for reproducing the same facts without acting on the past recommendations. Yes Minister!
Get on with the proven pipeline solution before its too late
Get on with it. West beach is dying
PLEASE DONT USE TRUCKS TO RELOCATE SAND. PUMPING SAND ALONG THE SEAFRONT USING PERMANENT INFRASTRUCTURE IS THE BEST OPTION AVAILABLE
No quarry sand no trucks, pipeline required
What has happened to the permanent pipeline option, bringing sand to west beach from the northern beaches which have sand accumulation?
I understand the desire to have lovely sand on beaches, but at some point we have to consider the planet and the impact we have on it. If the erosion is a natural occurrence then that is simply what it is. If it is as a result of human activity then that needs to be addressed to decrease the erosion of the sand rather than looking for a replacement option.
Whichever of the above highlighted methods are used, it will only be truly beneficial if undertaken in combination with biological and engineering works to reduce coastal erosion and reduce longshore sand movement. I would like to see an expert analysis of the latter options for this coastline based on the latest international science, followed by an opportunity for the community to comment on these options.
Sustainable solutions are available. One investment in a breakwater is the most sustainable and least disruptive to all.
PLEASE NO PIPELINE!
No
Building/Development on the dunes was, in retrospect, an ecological disaster. If climate changes accelerate and tipping points are reached (eg. major Antarctic ice loss), and overshoot cannot be managed, then a managed/planned coastal retreat may be needed.
Beach sand management is accepted as a requirement, but the quietest and cheapest option to submit residents and beach users to the minimum disturbance should be the only option considered.

The problem is being ignored.
The problem is longshore drift
The solution is slowing the drift
Other countries have had success with groynes offshore and parallell to the beach
This stops the zig zag motion of the sea and retards sand transport
You only have to look at the successful natural groyne at Port Norlunga.ie the reef....the beach there does not erode because the energy is dissipated
Create rock sea barriers in the ocean like they do in other countries. As example beaches on Santos's island Singapore
Need to maintain seagrass
Yes I walk at Grange, Tennyson,Semaphore and Largs on different days but could only choose 1!
There needs to be replenishment of the West Beach and Henley South beaches in order for this to be successful. They are decimated currently and only maintaining their current levels (plus the token planned tip up) is inadequate and unacceptable.
Do not destroy one beach to save another.
Limited detail on environmental effects of dredging sand deposits limits ability to assess advantages and disadvantages
Please do not waste tax payers money carting sand NORTH!
Mother Nature does that just fine.
Loose sand moves off the beach faster than by Long Shore Drift. Sand needs to be compacted through the water therefore the dredge would work best.
Use floating jetties to influence currents and naturally with with the ecosystems to redirect sand
In none of your options do you discuss the effect of the option on the current sea bed grasses and marine life,
None of the options offer solutions to slow the effects of long shore drift which in turn will reduce the 20 years costings to the public
It seems pretty obvious that dredging is on the table to save money, and it's a really really bad idea. Surely there is some other place to save money for South Road upgrades.
The ultimate scientifically supported sustainable solution needs to address the broader community interest. It's a tax payer money 💰 and needs to be spent at the interest of all South Australian.
Please include re-sanding Hallett Cove Beach too - it was beautiful and sandy when I was a kid.
From the Governments archives, the proposal considered by Cabinet in the Weatherall Government should be considered for approval as it addresses the area from the northetn wall of the Patawalonga entrance north to Margret Street or Anderson Avenue.

This would make available all the sand inthe contained area for beach replenishment elsewhere whilst retaining enough for a bettef beach in the shelter marina along the shoreline.
The marina would facilitate car parking and extensive world class marina facilities with any structures required being floating.
With the natural sand bypassing the area now, coastal management can select a suitable alignment for the breakwater which I understand is set out in the Cabinet papers
Mine sand from the west beach golf club. It's effectively a sand mine in the backyard.
Congratulations on the public consultation so far and for listening what the community has had to say and bringing science and sensibility to the debate.
I can't believe the sound of West Beach has been allowed to get to this level. West Beach has been robbed off at sand over many years. It's time for government to do something permanent. The semaphore and largs residents hold on to that sand like it's their firstborn. The large jetty on low tide is nearly out of the water. It's pretty obvious what is happening. It's time for some real change. I look forward to one of these proposals getting up and our beach being back to what it once was.
I suggest to plant coconut trees on the beaches to avoid such erosion to our beaches
It would be very worth while for your Management Review Committee to visit Luckybay near Cowell and see the fantastic job T Ports have done replenishing sand in front of Luckybay Beach.
As the Mayor DC Franklin Harbour I would take the time to meet your Committee and show you the beach at Luckybay.
We need to use the most efficient and effective solution as the issue is ongoing. State government must be decisive using science despite some community objections.
Needs to be minimal disruption of noise and beach access.
There was not sufficient information in the discussion paper to make informed input. There was no assessment of environmental impact of options or carbon emissions impact. There was no long term system change options presented. There was no explaination of why other options were not assessed. The options represent status quo and are not suitable options.
Any option needs to keep trucks of the beach and preserve offshore seagrass beds
Abandon the pipeline at Glenelg and dredge to southern beaches.
I wish this didn't have to happen at all. It would be good to know what happens if nothing Haven/ Largs runs out of sand?? Then what happens. Tha ks for allowing feedback.
A bunch of "solutions" that are just different unsustainable bandaids to cover up poorly engineered breakwaters, poor seagrass bed health, and unsuitable coastal developments. I can't even grade these from bad to worst as they are all expensive , detrimental to the environment, and unsightly.
Any decision on remediation for sand loss will be money poorly spent as coastal sea levels rise. Trucking sand to beaches that will not exist in their current form in the future is a huge expense.
Please stop taking beach sand from semaphore or Largs bay beaches. The sand at these beaches and north of Largs bay is so fine that it will not stick at West Beach. It's a lose, lose scenario and

everyone including the environment are the biggest loses. Why do we continue to waste millions of dollars of tax payer money to save west beach that is being impacted by a man made structure called holdfast shores.
I do not know why you guys are hell bent on destroying the Northern beaches. We still are showing the effects of the earlier sand carting. Sand is boggy, smelly black sub-sand is still showing. The sand grains of these beaches is way too small and gets washed away almost as quickly as it is placed on the beaches and ends up out at sea. Sand is not coming back to the northern beaches at the rate that it was in 20+ years ago. Studies showing sand movements are using data more than 20 years out of date. It ignores the effect of the marina built. This changes the sand movement. You'd only need to look at earlier sand carting efforts to see how hard it was to get the required sand needed from Largs Bay. I watched trucks go back and forth several times and STILL not fill a truck. It is hugely disruptive to those of us who use the source beaches regularly and since it does not even FIX THE PROBLEM you are just making our beaches a mess. Why not actually listen to Save Our Shores Semaphore?
I don't think this is a real issue and therefore not even a question that needs to be asked. Just keep beaches looking and feeling great, avoid disturbing our beach going activities.
For mine, more beach bars and day clubs. Give Adelaide a real vibe, mykanos, ibiza, bali, boracay style. That's where focus should be.
The pipe line between Glenelg and Seacliff is a proven system that works well why would you not continue be with this system
While it can be argued all South Australians (& tourists) benefit from maintaining the beaches, it is clear those who live closest benefit the most. (eg amenity & prevention of erosion of "their" land as climate changes.) I would like to see the gradual introduction of a means tested levy on properties to pay for beach management. The levy would be highest for properties on the beach front, and would decrease exponentially with distance from the beaches being remediated. Reaching $0 after, for example, 3km.
After the gradual intruduction period, the levy should fund all beach management without burdening properties beyond the example 3km zone.
Put in place permanent structures to help stop erosion and loss of sand
Yes. I think we seriously need to look at what is disrupting the flow. Its time to return the coastline to a natural dtate by removing all the problems. Glenelg marina etc need to go.
Sand needs to be recirculated North to South and supplemented with quarry sand or offshore deposits until the full metro coast is in a healthy state again. A pipeline achieves this and is done with a steady, constant flow.
I fully support hard infrastructure as it is less likely to be the victim of political funding and beauracracy as we have seen in the past. The Glenelg to Kingston model works and should be emulated as the uniform approach.
I do not support heavy machinery and disturbances. I do not support mining offshore deposits or quarry sand without a closed loop system.

Thank you.
Set up a pumping system to move the sand back to where it started. You will not be damaging established sea beds and electric pumps can be powered from green energy. Minimal environmental impact for maximum effect!
The Pipeline, near-shore dredging and beach sand carting must NOT occur - there are other options that are environmentally and financially sound that would not cause irreversible damage to northern beaches
Please do sound environmental impact studies on the potential irreversible harm that onshore options would have for northern suburbs beaches which are already eroding - this could cause catastrophic damage to these much loved suburban beaches - there are other solutions to improve West Beach
There seems to be few mentions of how sand loss can be slowed. Yes, dredge more into the outer tidal area, but also perhaps look further at shell reefs or small carefully placed froins as well.
An on shore pipeline with pumping stations has already been proven to be a waste of taxpayers money-it just doesn't work.
An adaptation plan needs to be enacted ASAP in conjunction with this. The problem is going to get worse with sea-level rise. Inaction now will leave future generations with a larger, more expensive problem.
We need to use the best information available based on scientific research to resolve this issue which has arisen due to mans interference with the natural flow of the sand.I would hope that politics is taken out pf the equation and that the best possible long term solution is enacted regardless of the expense.The current situation is unsustainable so tough decisions need to be made to reduce sand build up from areas such as Largs and North Haven and replace sand further south where coastal erosion is prominent
Yes plant more bushes and trees along our coastlines to hold the soil sand in place and explore options that do not include disturbing sea life...quarrying in seems least destructive
Consider building 'ocean pools' with car parks for access so that the 'coastline' can be enjoyed even if the natural beaches have disappeared. While this may not be cost effective in monetary terms perhaps it will have a less negative impact on sea life.
The extensive environmental impact of constructing and operating a pipeline does not make sense
PLEASE STOP CARS DRIVING on ALDINGA BEACH before so much damage is created that you need to start spending money trying to save it. There is no need for cars on the beach and it is just creating irreversible damage, including to the vulnerable hooded plovers.
Why is there not an option to spend the millions proposed here on restoring sand dunes including pushing back residential lines? For example remove sea front roads and replace with dunes.
It's brilliant that you keep trying to save our beaches
Please keep dogs of beaches without a lead. People without dogs cannot walk on beach due to uncontrolled dogs off leads

I was the inaugural chairperson of the first coast care group formed in SA in the early 90s, the Henley & Grange Dunecare group. This was at the time of the Glenelg foreshore development and the West Beach boat ramp.
I attended many seminars run by Coastal Management (DEWNR) about the affects of the groin development on the 'upstream' beaches. There was a lot of protest from within the scientific community and I witnessed at first hand the gagging of prominent scientists by the govt. to allow the development to proceed. They were warned of the consequences and cost. It's all come true.
Any option that is rolled out needs to be independently reviewed. The dredging options should also be supported by planting of seagrasses and man-made reefs
Sand trucking is noisy, disruptive and environmentally damaging
It feels like you're pushing towards a predetermined outcome and that is very disappointing.
I can only hope that consideration of the environment, cost, effect on all communities and visitors involved along the metropolitan coastline and climate change are all important factors in this extremely important, long term project.
Thankyou
Thank you for taking the time to review options. As this is about protecting all beaches.
Look at other countries' experience, specifically countries in Europe.
The beach is important for Adelaide, community, business and tourism, the least ecological damage approach and least imposing on fauna should be taken. Underground pipes need to be replaced, salt water is corrosive, leading to regular maintenance on a dredging crane from a jetty, also imposing in peoples fishing recreations. A dredging boat would be useful to pipe sand to where it's needed and spread with a loader. A minimal temporary sight.
Kalbarri, Western Australia where I lived for 12 months would use a dredging boat every year to clear and open the river for tourism and spread with loaders. It had little impact and was beneficial to the local community.
Ultimately as long as the beaches are preserved for environmental considerations and public use for generations to come, any solution is a good solution.
Adelaide shores should never have been built
I trust that the sand sourced by dredging would be of suitable qualtiy for beaches - i.e. clean, fine grained & light coloured. (I'm unaware of the difference between sands dredged from different depths/ distances offshore).
Install groynes at regular intervals along coast to trap and slow sand drift
Change happens with beaches. I've grown up in Tasmania where every year the landscape changed on all beaches every year but then it changed again the next year etc. was always evolving and gave nature a chance to showcase its strength and changeability. Loved it!
We have to stop thinking we can control everything. We totally mess it up every time.

the northen beaches are loved by the local community and all those visiting who live in the northern suburbs including Elizabeth, Salisbury etc.. Check out the beaches on any weekend to see the level of popularity. Why risk wrecking these beautiful beaches, They are the only "natural looking " beaches in the metro area, great for families, alive with seals and dolphins, fish and crabs and should be protected.
All these questions assume that 1. We want sand moved. Seems like a lot of $, effort and impact for a thin strip of sand. We don't all need a beach front. 2. That the public can determine environmental impact or other factors. Surely experts, not average punter, should make this decision.
I would like the pipeline to be used with minimal trucks on west beach. Safety and beach preservation are the priorities. A pipeline offers a good long term solution
I feel needs to be reviewed the dune line over the affected areas, without adding vegetation and a new dune line the problem will never get solved. These proposals are all temporary solutions.
Eco friendly options should be considered such as man made reefs and costal conservation. A report from an independent body needs to evaluate the options and outcomes
Although the plan documents said that protecting the environment was an important consideration, this was not addressed at all in the main text. To me this seemed evasive as it did compare cost, inconvenience and time. You need to provide clear information of the environmental impacts of dredging or pipeline vs. carting sand
A commend the process.
B have the dutch water authority also been considered for an opinion/assessment of this preliminary report.
C the unsuccessful options not in this section of the report may need further consideration as part of the gulf St Vincent improvement such as
1 a ramping up of the successful seagrass bed restoration project, 2 off shore oyster reefs piloted in KI
3 ongoing dune restoration
1. No trucks on roads. 2. Minimal on-beach vehicular activity. 3. Long-term solution.
I do not feel dredging or pipelines are a viable or environmentally sustainable option. The protected native sea creatures and dune dwellers are not being considered here. The dunes have been destabilized by the removal of sand from largs to tennyson (anyone can see that and plenty of photo evidence to support). Why not build more groynes or look at removing the marina past west beach that started these problems in the first place?
No
I support a pipeline to supply sand from the areas of sand build up at semaphore and fed via machinery. The pipeline would need to be hidden out of site and the pumping stations located so not to impact residents ie underground/out of site.

Yes. I favour the mass dredging of sand from seabed (using sand from seabed) and building it up. Will nourish the sea and surrounding beaches. Preserve the sand dunes as well and acknowledge work fine by volunteer groups along the coast.
All as above
Please think about the impact of those who live opposite the current operations at Glenelg. Our home life is invaded for many months of the year by noise, smell and obstructed views of the beach we purposely chose and paid a premium for the location.
Dredging is not a alternate genuine option + variances at this time.
We cannot continue to erode the Central beaches of Adelaide.
We cannot keep filling the northern beaches by drift without recycling sand.
We have enough sand currently in the system. This needs to be equally shared.
Drop the pipeline, it's to destructive and costly, dredging is best offshore and it impacting sea grass beds.
A fixed pipeline option and permanent infrastructure is appropriate as the issue isn't going to be solved by a temporary fix.
Either option 1 and 2 have unstated negative impacts or the least expensive solution involving the least community impact are the best options by far.
Solution needs to be low impact, both environmentally and visually. Offshore sand collection that doesn't upset seabed vegetation seems ideal. Can't keep having trucks on beaches or digging up quarry sand. Find a high volume of sand in a low environmentally sensitive area and pipe it down.
I want to see the same type sand pumping pipeline that is built down south from Brighton to Glenelg continued from West Beach to Largs Bay.
Our beaches are a great natural resourse for recreation activities but we cannot sackrific other areas to save another.
Ive seen what happened last time dreding happened at port Stanvac and it to 10 years for the beaches around it to recover. the tidal movements and weather cannot be predited or stopped. the real issue is global warming and the rising water levels of our oceans. there will be a time were we will only have a beach when tides out or man made beaches become a reality.
I appreciate the time that this has taken to undertake this comprehensive review. I'm pleased that, finally, we're thinking long term. My final comment is to impress urgency - the beaches are severely eroded and we need a long-term fix very soon.
It does seem that some within government departments will continue to either be influenced by those who can, or condone knee-jerk/bandaid solutions to fix problems that would have been avoided if scientific advice and informed public pressure has been heeded many years ago. Let us hope this does not happen all over and over and over again!
Good work with the community consultation. I saw an ad on Instagram which lead me here. Now get it done please :-)

I would like more detailed information on the three options other than the one-pagers presented. The 8-page consultation paper also repeats the same information on multiple pages and hasn't been proof read... This consultation has not been publicised to residents e.g this link. I'd suggest more proactive engagement with residents at West Beach and others affected e.g a mailshot with survey link. I'd suspect you will get a limited response - I only saw the ABC article (with no link!) and had to Google multiple searches and links to find this consultation survey. It's not a great way to engage effectively without further socialisation of how to access the survey.
Sand trucking on the beach has been a nightmare for years. This must stop!
Please consider the least invasive options and try to avoid environmental damage to sea grasses by using sand that is dense and obtained from the Murray mouth.
recycle to make sand they are non profit companies doing this in bali. they don't use plastic but glasses and natural elements, taking sand from one place and moving it only moves the problem, causes mass destruction and habitat loss. Also please make rule to only wear reef-safe sunscreen when in beach water as it has toxic chemicals that kill reefs, fish, wildlife and corals. don't allow dumping of oils and clean the sewage dumb that flows down into west beach. should not be allowed
I think this decision has to be made by experts taking into account the impact on the environment, ecosystems and costs. It is not a question about what looks best.
I have lived at my address for more than 30 years. The thought of digging up pristine sand dunes is ridiculous and any where in the would would laugh at us. I am a proven global entrepreneur and in less than 2 weeks of finding out about this last time my first calls were to a dredge company to cost which are similar to the Departments. If well managed it will work and be flexible and environmentally friendly. We even talked to the Murray Mouth Aboriginal People about using the sand we pay to dredge there which is the perfect size and we could finance a Dredge and employ indigenous workers and almost set them set up a business. Not un similar to how the government did not want to sponsor a Surf Rescue Helicopter and I set it up as an independent business now operating in 3 states and is worth $20M a year. Joining the dots on Entrepreneurial Solutions is not a Government Departments core skill. It requires out of the box thinking. At least wit the Dredge we will have lots of options.
The Brighton to seacliff pipeline WORKS - do that
PLEASE do not let politicians or residents without knowledge decide how to treat our beaches. We need them to last many more generations yet and we should have sand on them. Let the experts with the correct scientific knowledge make these decisions or nothing will ever be fixed.
The real solution to our sand migration from South to North along the Adelaide Coast Line is the construction of Groynes. Not a pretty option but the only real solution and one the Government can afford long term. 1) Start building Groynes at South Brighton then add 1 or 2 each year moving North along the coast. 2) Truck sand from Larges Bay North & North Haven to Brighton. The sand will start building up at Brighton and gradually restore the coast all the way to Point Malcom. In 20 years no more maintenance required (nil cost), Beaches restored and Groynes built up with sand

have blended into the coast line. And if we are luck the Seagrass returns and assists with maintaining a sustainable fish population.
No.
I use the beach from Largs Bay all the way to south of Henley Beach. I am a regular beach user and have found the trucks to be intrusive, and the northern beaches ruined by this method.
From Largs to North Haven there is now too much sand , put it back where it belongs
The better we keep our beaches the better
Will continue to attract visitors and locals to the area and when they get here they will spend money
The dredging options are clearly preferred as they meet all three requirements of any solutions, they are flexible and responsive and are worlds best practice and they are the cheapest.
I have seen children in VERY dangerous proximity to trucks. I have seen children lying, invisible, in deep tracks. It's a miracle none have been run over. The trucks speed. I have clocked them at 50K driving on the road next to them. Trucks on beach are a construction site and equivalent safety measures should be taken. I cannot believe Worksafe SA allows this
Henley Beach South and Henley Beach are not mentioned. In the DHI report it states that the erosion issues have occurred at West beach will migrate to Henley Beach South. This has occurred and we are now experiencing erosion, wet beaches, significant loss of sand, loss of berm, dune destruction and our beaches are seriously depleted and out of equilibrium. The DHI report recommended 500,000 plus c meters of sand for West Beach as infill and 300,000 c meters of sand for infill to Henley Beach South. There is an assumption in the Bluecoast report that there is beach access for trucks at Henley Beach South. There is not. This needs to be addressed. At the moment sand delivered to West Beach is bypassing Henley Beach south and Henley Beach and is arriving at Marlborough Street and further north. If sand is delivered into the tidal area of West Beach it is highly likely to be caught in littoral drift and will quickly flow to the north. It will continue to bypass Henley Beach South and Henley Beach. We need a system that provides sand to all beaches.
Sand moves alongshore to the section bank. Go get it back with a dredge. Easy! Seems like vested interests want to run trucks
The technical report is too complex for many of the locals, but the pamphlet leaves out too much detail to help people make an informed decision. I would have like to have seen a much longer term approach with costings and positive and negative impacts clarified. But otherwise I would just like to re-iterate NO PIPELINE OR PUMPING STATIONS OR ASSOCIATED INFRASTRUCTURE. Sorry for "yelling" but I am very concerned about the negative impacts of those options.
I do hope more information about the environmental impact is made available about the newest and seems potentially the better option of dredging. We need to hear how it is going to happen and what lengths are gone to make it's environment impact minimised.
Hopefully it's all good
If houses were not approved to be constructed so close to the beach then the problem would not exist?

I was born and bred at Largs Bay. I've lived all my life along the coast as a resident and sailor. 50 years ago I remember when the bottom area of the Largs Bay Sailing Club would flood on a spring tide and a winter westerly...now it's 100m through the "dunes" to the beach. 50 years ago I remember when a high tide would come up to the rocks at the edge of the Largs Bay Sailing Club Car Park....now it's 100m through the "dunes" to the beach. 50 years ago there were NO Semaphore and Largs Bay "dunes" they are 50+ years of accumulated sand from beaches and areas to the south. There's plenty of sand available, it's on the beaches at Largs and Semaphore....it just needs to be returned efficiently back to where it came from. There's no need to dredge near or off shore, there's no need to use transport and energy hungry quarry sand. But there's an URGENT NEED to listen to the science, not the loudest voices. Look at the obvious, not the complex. An URGENT NEED to do what's right for the entire coastline, not just some areas.
Sand pumping pipelines work in other parts of the country and indeed it works between Glenelg and Seacliff. It WILL work between Largs and Semaphore down to West Beach IF the science supports it and the GOVERNMENT is willing to make it happen.
No pipeline!!!!
Consider fixing the problem rather than Band-Aid approach.
Please ensure south section of Glenelg North does not miss out on this!
In reality the pipeline solution is the only feasible option.
The sand in the system is everyone's. We are after solutions that make all of South Australia a better place. This is a partially man made problem with unnatural consequences. The loss of the sand in the middle beaches will mean they soon won't be able to be resurrected. The catchment of sand to the north is burying infrastructure, this means the sand is also being taken out of the system and piling up at a totally unnatural rate. The answer for all of SA systems to work together as it has been doing in the Glenelg to Seacliff system with huge success. With all of the methods the pipeline and filling it from the beach from the north and depositing it on the beach where it is needed best is the answer for a sustainable and cost effective long term method. Quarry sand at the moment is about 10x the cost to place on the beach and therefore not feasible in long term solutions.
We have been constantly told the standard we are after is the 1970 base level. Whatever method we choose we need a mass fill to maintain that 1970 standard.
We really need this now (well 20 years ago) or endanger turning West Beach, Henley South, Henley North into unusable beaches. We only have to look at Hallet Cove to see what any government can do - Hallet Cove now has no Surf Life Saving Club as no one can swim there. I can't think of any government or premier that wants to be remembered for not saving the city's beaches. Whilst the government or premier will be remembered in history.
No
The pipeline along the seacliff, brighton and glenelg beaches has delivered the wealthiest suburbs perfect increased levels of soft white sand, without blocking their expensive views with massive bushes, while the less affluent suburbs are denied the same. Where is the equity and social justice? West Beach suffers the most.

The answer was there and now the government has wasted time and money to the detriment of the environment and the people who enjoy it for biased political reasons
The only long term viable alternative is to allow nature to take its course. This may involve removing buildings from the sand dunes. If done with forethought, this could be manageable; if left to the next storm it could be catastrophic. The sea and the forces of nature are stronger and more enduring than humans.
My hope is that those making these decisions put the best interests of our entire Adelaide beach system first & do not become swayed by political bias. Adelaide beaches are the envy of many around the world - lets keep them that way !!
Need to edducate more people 4wding doesnt kill the beach rising seas do
It wasn't mentioned the greenhouse gases that would be generated through each method and if there was a better choice from that perspective.
Follow the science
see previous
yes to Dredging--but No to trucks and pipelines!!
I'd like the gov to do another study on heavy equipment moving along Bower Rd. I don't accept that the state gov thinks heavy equipment is ok to move along this path - it clearly rattles our house and windows and that can NOT be good for our house or others along the pathways taken.
This 'have your say' does not include enough information for the community to make real, effectual opinions. There is no mention of what environmental impact these sand movements are having and other options will have.
HELP SAVE WEST BEACH & HENLEY
Unfortunately the survey didn't allow me to input 2.1 due a malfunction. This is the only option that already operates successfully along our coastline and has had previous approvals. All other options will not happen even when further researched as this evidence has been sought previously.
Dredging with offshore delivery seems infinitely better than any options that involve disruption to the beach and dune environment with pumping stations, pipelines and trucks.
It preserves the social environment of the beach, is cheaper, less noisy and less disruptive to beach users and to local households.
Think of Your gand children. Your responsibilities
Last summer I witnessed these trucks near semaphore south beach wasn't that far from where people were swimming. Continually going back and forth polluting the air from the diesel trucks. Noise pollution as we could hear them. Risk of a child or dog being hit by them as the driver is way up high.
No trucks on the beach!
No pipeline!

Disgraceful this has taken so long as it already has. The solution is plain for all to see and is already in place for southern metro beaches. Enough of the political handballing, build the pipeline for northern beaches and finally start the process of repairing the severely degradated central metro beaches
keep the trucks off our beaches please
Why aren't early 20th century photographs being used to prove that thousands of tonnes of sand is being deposited on the beaches over time and the sand would not be deposited because of the structures built in the gulf.
A pipeline was approved by previous government, then cancelled by the new government. This problem could have been solved by now if not for selfish politicians and residents of northern beaches
West Beach is in desperate need of a resolution to the sand drift issue. I believe and understand that option 2.1 is the best environmental resolution and least disruptive
We've been contributing our sand to the beaches further south for decades, and it is a short-term fix to a long-term problem. It is NOT a viable solution.
I find it difficult to reconcile the delay and degradation to West Beach for the sake of a number of previously rejected options. All that has been achieved is delay and further degradation of coast.
I would like to know what criteria are going to be used to assess the option to be implemented. This all seems rather pointless if you already have a set of decision criteria/weightings that reflect a predetermined outcome. At the end of the day it is easy to sway the process if you have control of the decision making criteria.
Is there an agenda reflected in the decision making criteria?
What are the criteria for making the decision? Susan Close stated early on in this process that insufficient weight was previously given to impact on Amenity as Semaphore. If that aspect of the decision making process is going to be given undue weighting, then this whole process is likely an exercise in public relations.
Can you please publish the criteria/issues/weightings to be used to make this decision.
On the info sheets i couldnt find any info on how would effect the coastal ecosystem so i dont feel this is an educated choice on my part
I support the work of Save our Shores and believe they are working very well with community and trying to put forward good ideas to the Department to minimise harm and maximise sand on beaches at the necessary locations.
I do not believe that the options canvassed are fully informed by contemporary knowledge and world's best practice.
I believe that the best solution will not be a single option at a point in time, but will need to incorporate an evolutionary approach as learnings occur, technologies are developed and improved, and investment lead times are accommodated.

Flexibility and responsiveness are therefore key components of the optimal solution.
It behaves the government and environmental agencies to protect all beaches, foreshore environments and the public, while being fiscally responsible. Please consider a wide range of stakeholders in making the final decision, rather than the loudest voices. Also, please consider where public money is being spent, for the best benefit of all South Australians.
I do not think we should be destroying one beach to save another. The off shore collecting of sand seems to be the best option.
I feel beaches are for relaxed public use & having large machinery on them negates this. When on the beach we shouldn't be looking out for traffic & the huge holes that get left.
Only the dredge barge options have minimal disruption to beach amenity and communities, are the most flexible in that they can source and deliver sand wherever it is required along the coast, are the most sustainable with rising sea levels and the most economic.
Sand pipeline options are very expensive to build and maintain the infrastructure, inflexibility in accessing suitable sand and where this can be discharged, significant microplastic pollution produced over its lifespan (approx 50% of the pipeline plastic is abraded) and loads sand on to the beach. Existing trials using better quality quarry sand delivered on to the beach have shown even this is quickly eroded. These options produce environmental damage, social anxiety, escalating economic costs, decreased open space amenity, microplastics in the environment, as well as the possibility of a stranded asset at end-of-lifecycle. We have already seen how 100,000m3 of coarse quarry sand, delivered onto the beach face at West Beach, has eroded swiftly and represents very poor return for the tax payer dollars invested so far. A back-passing pipeline, delivering finer grained carbonate sand from northern beaches, would be even more ineffective. Significant microplastic pollution are produced over its lifespan (approx 50% of the pipeline plastic is abraded) delivered to the marine environment inthe sand slurry. These options produce unacceptable disruption to beach amenity and communities - trucks, tractors, noisy trommels and restricted access for four to five months of the year to be left with unstable beach profiles highly vulnerable to storm damage.
I have spoken with the Sunshine Coast Chief Coastal Engineer about their very successful dredge barge trial delivering sand to the nearshore which they have just completed at Maroochydore. The technique is also being used at Stockton Beach, NSW and in Coogee and C Y O'Connor Beaches in WA which replaces previous sand pipeline useage.
The dredge/barge discharge to the nearshore is routinely utilised widely elsewhere in the world and is particularly favoured by the world experts, the Dutch in their coastal engineering. DEW appear to have been stuck in a sand pipeline mindset using technology from last century and have ignored techniques worldwide which can provide a flexible, non disruptive, effective (not cosmetic) and more economic strategy for Adelaide's beach management.
I commend the State Government for this review and can only hope that unlike what eventuated from the 2018 DHI study (which similarly promoted a dredge barge mass nourishment strategy) that DEW accept there are better more sustainable and economic strategies than just pushing sand in an expensive pipeline.

Please consider the most flexible option to dredge offshore with no permanent fixtures like a pipe line. I do not want trucks on our beaches as I go there to enjoy the natural environment and get away from things like trucks.
Do SOMETHING before the beaches disappear
Collection of sea weed at osborne makes the beach stink at low tide. The amount of sea grass that doesn't wash away makes it difficult to use the beach even in summer
Vegetative growth harbours so many snakes and foxes that don't feel Safe using the path as it is neglected and play ground path behind has so much vegetation that snakes are often near playground
The Metropolitan Beaches are important to the economy and general well being of the community for recreational and other purposes. The investment in maintaining the beaches ongoing is critical to sustaining their value. Imagine Adelaide's foreshore in 10-20 years time if we do nothing. That is simply not an option. Option 2.1 will see the completion of a pipeline which is proven by successful implementation of Stage 1 (southern beaches). Let's not delay. Let's not do more studies. Let's do it.
Dredging sand is NOT an option due to destroying (smothering and choking) reef and seagrass habitat. Dirty water blocks sunlight and so kills seagrass. Thick silt cover kills healthy reef habitat.
We have already lost 80% of seagrass along metro Adelaide. Dredging would reverse the increase in reef and seagrass health
Seed for Snapper project - fishers
Waste water - Bolivar
Greenfeilds wetlands /recycles water
Shell reefs
Thanks for making changes to the survey based on feedback on the previous survey. Community groups pushed for broad community consultation but there has been reduced access to the community this time, in particular if people do not use Facebook or Instagram or email. The have yoursay online component is not particularly user friendly for those who are not confident with such systems, and ABS census data shows that there is a significant degree of low computer literacy in the community. Disappointing there were no postcard notifications, perhaps because of costs, but that has put the onus and expenses onto community groups to provide information. This is hardly the way to gain community support and trust. The consultation time is short - only four weeks- during a busy time. For instance the consultation time has coincided with the AFL football finals/grand final, school holidays, the Voice referendum. The stakeholders meeting was held 9 days after the release of the shortlisted options, making it even more difficult for community groups to inform the public. I would have liked more information in the general handout, and many will be intimidated by the technical report. As this is an important review I would have preferred to see much more time and resources allocated to the consultation process.
KEEP TRICKS OFF BEACHES. A pipeline will ruin many dunes and add more microplastocs to the acquatic environment

I'm worried that the first few options seem like the least intrusive and most cost effective but that is not always the best option for the environment which is think is the most important thing here. So I think considering the environmental impact for each option is necessary to make a final decision.
Environmental considerations or potential impacts were not included in the discussion paper.
There is a lot of propaganda around how much the dunes have been eroded at Largs Bay. As a new resident in the area in the last 2 years I've seen how the sand has built up north of Largs jetty not eroded! Let's shift some south.
I visit West Beach every morning and have observed the current practice of moving sand using trucks and machinery. The trucks appear to be operational for many months at a time, creating a safety risk to beach visitors. If the objective can be achieved by dredging existing sand near the shore or large offshore sand deposits for less cost, these appear to be the most efficient and effective options. The dredging work should happen over the winter months when the beach is less populated.
The option chosen must reflect up-to -date environmental science research rather than merely be the cheapest option, including rehashed DEW plans that are long out of date
I'm not in favour of dredging the seabed for sand
Not sure if I missed the extra info but it was hard to pick an option to support without being informed of the possible impacts..??
There is no evidence of the present sand carting program benefitting the retainment of the local coastline. A long term plan should be developed which looks at ways to reduce the impediment of the natural flow of sand. This should include restricting further development on the coast, reclaiming dunal systems and removing infrastructure from dunes which protect further intrusion into the residential area. This will be a greater challenge as global warming increases, sea levels rise and storm activity increases. On no account should further excavation and transporting of sand be conducted.
The aim should be to deal with the problem in a way that disrupts the public the least, both in terms of traffic on the beach & nearby roads. You should endeavour to maintain the beauty & tranquility of the shore.
The DEWR have been very underhanded in the way they have supported the harvesting of sand from northern beaches, as well as their comical pictograph that is NOT evidence based to inaccurately portray the migration of sand.
Their first survey was designed to reduce and manipulate respondent choice.
Sand is NOT a utility that can be robbed from one beach to replenish another. That will be massively divisive and does not support the alliance of coastal communities. The problem at west beach has clearly been caused by both the holdfast shores development and the west beach boat ramp and groyne. Additionally the installation of the new surf lifesaving club at west beach is not only obnoxious but also will further disrupt the natural hydrological processes of our beach ecosystem but accelerate further degradation of the next beach/es north, viz. Henley and Grange.

It is time to get this sorted.
The web site provided a lot of feedback information but I could not find any costed government reports or summaries outlining the options, pro and cons and costs.
I feel this project has been swayed by vocal public option and is not be guided by sound scientific advice and prudent cost management
Do not destroy our beaches by installing a pipeline.
Please restore sea grass beds
Please divert more of the river Torrens and Patawalonga storm water to reduce pollution in the gulf and help sea grass to recover
why has this taken so long to effectively do what was already in place prior to the last election?
Follow the science. The pipeline has been proven. Susan Close needs to do what is best for ALL beaches not just her own. Replenishing West Beach will help Henley and Henley South to recover also. It's a crime what has happened to the West Beach dunes in the past decade and more. Political agendas should not get in the way of environment.
An environmental impact study needs to be done (an independent one) cost options need to be considered, the current picture of sand moving from West beach to Semaphore needs to be removed as it is incorrect. Trucks should not be on the beach!!
The Beach environment belongs to everyone and is a resource for current and future generations. Historic man made interventions have changed the natural sand replenishment process and currently the beach condition is worsening rapidly, to the detriment of the community. New approaches are required to address the problem.
There is an existing model which has community support and maintains beach conditions between Glenelg and Seacliff, this would be a logical approach to address the issues to the beaches North of the Glenelg marina
Whilst trucking sand on an ongoing basis will work it is expensive and not as environmentally friendly compared to an ongoing pipeline system from North to South.
The key requirement is urgent action and attention to this problem now, otherwise the West Beach, Henley South, and Henley North beaches will deteriorate steadily until some time in the future when they will no longer exist as beautiful, natural places for the community and wildlife to enjoy.
Please listen to science not politics
I do not believe that the options canvassed are fully informed by contemporary knowledge and world's best practice. I believe that the best solution will not be a single option at a point in time, but will need to incorporate an evolutionary approach as learnings occur, technologies are developed and improved, and investment lead times are accommodated. Flexibility and responsiveness are therefore key components of the optimal solution.
Thank you for all your investigations and allowing feedback.
Please return sand to West Beach :)

Could not see that a groyne was considered or part of one of the options, to at least contribute to slowing rate of erosion.
I don't understand why the use of offshore breakwaters was discounted as an option.
Get on with it - this is long overdue. The residents are fatigued by rhetoric and increasingly inflamed by the political favours in-play.
A solution where all communities along the coast are viewed equally and without political-favour is essential to achieving safe and suitable beaches along the stretch of our coast for all South Australians to enjoy. The trucks have got to go - they are a terrible nuisance and hazard, and an inefficient use of tax-payer funds.
Sand mining and pumping are intrusive and costly and to be avoided when there are other more effective options which clearly work. This should not be an us and them issue between West Beach and Henley South residents and Semaphore/Largs/Taperoo residents, not to mention residents of beaches in-between affected by a proposed pipeline that will be both costly and intrusive to build. The problem of sand loss from Henley and West Beach requires a holistic view which recognises that there are going to be more and more frequent severe weather events and storm surges which will wreak havoc not only on those beaches but right along our coast, including the northern beaches. Flinders University studies show that the Lefevre Peninsular is slowly subsiding and that sea levels have already risen meaning that sand mining which leaves the dune systems vulnerable is shortsighted and permanently damaging. These dunes are environmentally important, they are home to many rare plants and animals and part of the broader coastal ecosystem. They also offer some protection to low lying suburbs along the peninsular and should be protected at all costs.
The sand erosion has been there for years and multiple reports have been written, it's time to act, the best solution for our beaches should be number 1 not local politicians
The various experts on this sand issue that i have heard speaking suggest returning the sand that has been washed north by natural flows to the areas they have come from.
Interfering with the environment will be a never ending waste of time, resources and money, which can be better directed by the Government into more productive areas such as Hospitals, Roads and Schools.
An outcome that involves the least impact to the marine and beach environments needs to be chosen.
I understand all options will have a negative environmental impact and at this stage the dredging option seems to have the least impact as well as being the most flexible and community oriented.
Consultation with traditional owners and consider long term costal development options and restoration of ecosystems
2,1 is the only solution
All of your proposed solutions are poor & do not consider a preventative approach, nor do they address the underlying cause ..

When the port river is dredge deeper for new subs This dredge could be used. Maybe the Murray river mouth would be a good source of sand
Build the pipeline and feed it by dredge or by other methods. This infrastructure is the least disruptive and most efficient long term solution. Need to act NOW this issue became politicised under Labor and has been a disaster for West Beach and Henley
Look at ideas from other countries.
The past 10 years of trucks on West Beach, specifically taking sand from near the Outlet and moving it south to the caravan park for several years, caused massive dune erosion as the storms came in further. Short term solutions do not work. What has been done since Adelaide Shores was built does not work. The build up of sand in the northern beaches is proof of this. The sand from the northern beaches should be used to restore the central beaches. This is a permanent low cost solution, achievable with a pipeline that will last for years.
If you keep doing what you have done, you will get the same result! Current strategy of sand harvesting and depositing at base of dunes further erodes the beaches as the sand in undermined at the next high tide. This is costly, disruptive and useless and must be stopped! Look at the international and national successful strategies and evidence and follow their direction.
Listen to science, protect our sea and land environment, made sustainable decisions.
Dredging would be consistent with worlds leading practices
Are there other options considered? Inserting breakwaters, groins or seawalls to restrict the northern silting / erosion?
What about the disappearing sand at Moana, Sellicks beaches?
The littoral drift of sand from south to north has NOT resulted in a build up of sand on Henley North, Semaphore and Largs Bay beaches. 2022 DEA CSIRO satellite imagery shows that over the last 30 years, 30m of beach has been lost from Largs Bay and 70m of beach has been lost from Semaphore. These beaches cannot be used as sand mines; it is destructive and clearly not sustainable. Therefore In my view, options 2.1, 2.2, 2.3, and 3 are a folly.
I understand all options will have a negative environmental impact. At this stage the offshore dredging option seems to have the least impact as well as being the most flexible, the most economical and the most community friendly.
To avoid further environmental disaster being perpetrated on the metropolitan coastline including offshore seagrass meadows, bird habitats and dune flora and fauna, it is essential that an Environmental Impact Study be carried out on whichever option is chosen.
I don't believe any of these options are the answer.. The rock wall at Glenelg that prevents sand through to West Beach needs to be reviewed.. The amount of sand on beaches wasn't an issue until humans started playing around with sand/ beach management... I am genuinely concerned that all 7 options will continue on the path of irreversible outcomes.
1.What consideration of the current state of the beaches impacted by sand mining will be presented for the consideration of affected communities and groups?

2. If further assessments rule out the dredging options do we, by default, fall back to the pipeline options as the only viable outcome?
3. Where is the evidence of consideration of the impact of changing weather patterns on shortlisted options?
4. Is there an upper limit to what government is prepared to spend on beach management and has any cost benefit analysis been undertaken to more fully assess the shortlisted options? eg What is the cost to local businesses of closing the jetties for 4 months of the year? What is the cost to public amenity of having noisy equipment and trucks operating on popular beaches? It seems like the only costs presented for consideration are actual infrastructure and operating costs - how are the social costs being factored in? If no community tolerance model is implemented what faith will an already 'low trust community' have in a proposed 'solution'?
5. What weight do the survey outcomes carry in considering which option will be chosen?
6. The aspirations of Mark Searle to achieve harmony along the coast between communities with different needs are admirable and desirable but do not fully take account of the years that communities have had to endure flawed consultation processes, promises and undertakings that were not adhered to, the non disclosure of significant detail about the previous proposed northern pipeline (including on the morning of the 1st day of presentations to the SCAP), the rushing through of approval processes prior to a State election, a perceived lack of consideration of climate change impacts, a lack of appreciation of the depth of feeling about the loss of amenity and damage to foredunes experienced within our community. The panel need to fully grasp the hurt and distrust felt by affected communities - we are not just passionate we are 'pissed off'. Whilst faith has been placed in this 'independent process' and attempts to find more acceptable solutions is appreciated the road to achieving harmony is a long one and needs far more resourcing than has been allocated to date. This 'engagement and consultation process' will continue to be seen as a tick box exercise only rather than a genuinely independent process whilst communities remain divided and distrustful.
Do the majority of this work in Spring/Summer to maximise the better weather and the minimal long shore drift during these seasons. And prioritise the mass planting of vegetation and installation of fencing to retain and grow sand dues, and include better signage to keep people out of these areas whilst also informing them of the benefits and reasoning.
Safety is of prime importance and trucks and people do not mix
An off shore dredge pumping to a pipeline that then distributed sand to the required places seems the most flexible and safe option
Please let the science decide for the benefit of the majority and keep the politics out of the decisions moving forward.
My observation is that the problems commenced with the introduction of the West Beach marina and other construction on the foreshore. This benefitted a few priveleged at the expense of nature and the rest of the community. Go back and undo the cause of the damage.
Reduction of fresh water spilling into the gulf which is killing the sea grass
Reef 100 metres offshore to capture sand

Definitely NO PIPELINE
Something needs to be done asap
No
No
Any of these actions/activities would erode the beaches north of semaphore causing issues here in the future, then what would happen? All the sand would be brought back to fix that?
Use gabions of rocks to stop erosion & truck inland quarried sand to non beach location, onto a boat that can distribute it off shore where needed without the need for dredging. As stated above in my last statement
GIVE US BACK OUR SAND
Why can't we as concerned residents and beach goers, combined with the government, get this sorted rather than it being unresolved year after year?
Time is of the essence
Do not create new problems by sourcing sand from other Adelaide beaches. Source the sand from the local seabed
It would appear from the consultants technical report that the options proposed are from experience on the east coast of Australia, which are significantly different from the conditions along the Adelaide coast, primarily because of the extensive seagrass beds.
Furthermore, the dredging options are not to varying extents sustainable compared to recycling sand, and require diesel as the motive fuel.
There is a high risk that the dredging options will cause unacceptable turbidity in nearshore areas affecting bathing water quality, or further offshore adverse impacts on reefs and seagrass meadows.
It seems to me that one of the dredging options, whether that be just dredging from Options 1.1, 1.2. and 1.3. or the combination of dredging and pipeline in Option 2.3. are less disruptive to beach users than the other options. I think I would lean towards Option 2.3. as my preferred solution as a pipeline appears to deliver the sand directly to the beach in an efficient manner, but the combination with a dredger means less disruption to beach users than using machinery on the beach.
The pipeline is the most viable and proven option and should be implemented immediately. The department and government has to show strong leadership to ensure this option is implemented, even if it may be unpopular for some minority groups.
Please consider the health of the marine environment
Trucking the required sand from quarry and northern beaches will need to continue until a long term solution of piping and recycling the sand is constructed.
Sand removal and carting by trucks along Semaphore and Largs has been ongoing for 30 years or more or since I have lived in this area and is no longer a good environmental or economical solution.

While it is acknowledged that some Adelaide beaches are losing sand the solution should no longer be to rob one beach to rebuild another.
Keep trucks and dredges away from northern beaches!
Please consider off shore dredging and quarry sand carting only.
This project has the potential to cause irreversible environmental, social and financial damage to northern beaches.
Please complete environmental impact statements for beach sand carting, a large sand pipeline and on-shore dredging before proceeding
No quick fix measures please!! In an ideal world the long term solution would involve getting rid of the boat harbour and Holdfast Shores which created this mess in the first place! i have seen the beaches dramatically change since this development occurred - despite protests against this devastating development.
Think preservation of the seabed is important as it's supports the ecosystem
I would like some action to take place soon. Nothing seems to have happened for some time and the beach is eroding more.
as the sand has drifted to the northern beaches it should be removed from there
The issue that has caused this problem is easily identified and is not going to be removed, therefore carting is a costly and temporary solution. Unfortunately we must learn from the same mistakes that have been made up the Eastern Seaboard and apply fixed structure solutions that will change the landscape of our beaches but give opportunity to slow the sand migration and possible opportunities to slowly restore the dune systems
Have lost between 30-70m of beach in 25 year at Semaphore and Largs. Please work to protect this.
Definitely do not support any pipeline. Only support carting if only quarry sand is used. Support dredging if it takes place at least 2km offshore and there is an environmental impact statement.
As a resident of Henley Beach I am deeply concerned as to state of erosion and some drastic fast needs are required to be implemented as a long term solution that is also cost effective. The government needs to step up and provide support to support this action
Absent is any information about the marine impacts of dredging. How can anyone make an informed choice on this survey or any relevant insights when it is missing basic and crucial information?
Once our infrastructure department is misleading residents #hovecrossing.
Listen to the environmental scientists. Have we learnt nothing from climate change or Adelaide's history of messing up the beaches? As a student at school, we studied the devastating impacts of the (then proposed) Glenelg Marina in long understood science and basic long shore drift. Politicians told us the science was wrong and went ahead anyway. Billions of dollars later we are still paying for it. Let's not mess up the Marine ecosystems by dredging and damaging the sea grass and marine system.

there is no mention of an environmental impact statement on any of the proposals
yes fix the original problem the patawlonga outlet and buildings at glenelg
Not at this time.
Please be considerate of the culture of current suburbs and other communities that may use these shores. Thank you.
I would prefer the least disruptive option for animals and humans. It would be better if something could be done to hold some sand at West Beach etc instead of constantly dredging and moving sand around but I don't see that listed as an option. Would a breakwater or artificial reef not help?
What is the environmental impact of dredging 2km offshore?
NO PIPELINE!
NO CARTING!
More beach goers would answer this survey if it was advertised along beach ramps. I only found out from a friend.
I have 3 concerns re the overall process at this stage.
Firstly the definition of the review is that it should consider disruption for all communities, and environmental harm, as well as the basic problem of keeping sand on the beaches. There is no evidence that these other criteria have been examined, which makes commenting on the options difficult and subjective. The only factor which has been considered is cost, relevant but not to the exclusion of the others.
Secondly for some of the options there is still a large amount of investigation required, which will take yet more time and delay solving the problem, particularly critical for Henley Beach South.
Thirdly, I acknowledge that the Technical Report is still at draft stage, but there are a number of basic errors, such as placing roads in the wrong suburb (Henley Beach Road is not in West Beach), inconsistencies between the written word and the diagrams (words omit pipe outlet at Henley Beach South), and incorrect diagrams of access points for bulk sand (shown as by Henley Beach Sailing Club, when should be Adelaide Sailing Club). I got the impression that the writers were unaware that Henley Beach South existed, or that it had considerable current problems. Together with selective reference to previous studies (noting they found there was sufficient sand at Port Stanvac, but not that it was found to be unsuitable for use on the beach), this tends to remove credibility from the review.
More research is required, specifically for individual Environmental Impact studies and statements.
Just hurry up and get the job done. the previous government had an answer happening, but now we have to have another review done. how many have there been? stop procrastinating and get on with the job. the review was supposed to take 12 months, we are now well over this and the report hasn't even been written yet?
Why do we, as a community, have to outlay a huge expense to achieve something that can be done by dredging which won't affect the landscape of our beaches or impact residents, beach goers,

tourists. Our beaches are beautiful & shouldn't be spoiled with pipelines, trucks, tractors, pumps - imagine the noise! Not to mention the cost.
I can not believe we are still debating this issue. The government won an election on the promise of ditching the pipeline and sand mining and yet here we are.
Listen to our community. No pipelines sand carting or machines on beaches.
Trucking seems an ancient non environmentally solution
be logical in decision making not based on $.
Create a circular ecosystem from where sand is accumulating and return to where sand is depleting.
Do not dredge. While scuba diving I personally witnessed damage caused by turbidity, sedimentation and reef smothering at Port Noarlunga reef due to previous dredging that occurred at Port Stanvac. I am completely opposed to dredging in SA waters because of the environmental damage it causes to coastal, estuarine and marine ecosystems, including reefs, seagrass and benthic marine life. In addition, water quality is likely to be affected and could lead to environmental nuisance where swimming occurs. It will also potentially have an economic impact on tourism and local small business, especially diving companies.
Please ensure solution is backed on scientific environmental impact and impact to local community
2.1 is the only long term solution with the least environmental impact which should be at the forefront of any decisions. This has worked for our southern beaches as a result of the last coastal scientific review. Let's do what has been proven successful and not be in this same predicament years down the track.
I support the save our shores position who keep us well informed
Regular disruption or limitations to many beaches should not be considered. Our wildlife and dunes are precious and should not be damaged. Limit disruption and public danger to only the beach being replenished.
Learn from what other forward thinking countries have done
Only dredging offshore it a long-term solution for all eviromental concerns and effectiveness.
The pipeline will definitely ruin our beaches
The sand in the system is everyone's. We are after solutions that make all of South Australia a better place. This is a partially man made problem with unnatural consequences. The loss of the sand in the middle beaches will mean they soon won't be able to be resurrected. The catchment of sand to the north is burying infrastructure, this means the sand is also being taken out of the system and piling up at a totally unnatural rate. The answer for all of SA systems to work together as it has been doing in the Glenelg to Seacliff system with huge success. With all of the methods the pipeline and filling it from the beach from the north and depositing it on the beach where it is needed best is the answer for a sustainable and cost effective long term method. Quarry sand at the moment is about 10x the cost to place on the beach and therefore not feasible in long term solutions. We have been constantly told the standard we are after is the 1970 base level. Whatever method we choose we need a mass fill to maintain that 1970 standard. We really need this now (well 20 years ago) or

endanger turning West Beach, Henley South, Henley North into unusable beaches. We only have to look at Hallet Cove to see what any government can do - Hallet Cove now has no Surf Life Saving Club as no one can swim there. I can't think of any government or premier that wants to be remembered for not saving the city's beaches. Whilst the government or premier will be remembered in history.
There is only ONE plausible solution to the problems of Adelaide's central beaches and that is to instal a pipleline from the northern beach (Semaphore, Largs Bay). This is an established system, operating successfully from Glenelg to Kingston Park. It has EPA approval already.
The remainder of the options are just pipe dreams, that are unlikely to receive EPA approval.
Dredging is not a suitable alternative, due to the high environmental costs
No thanks
Stop holding residents at West Beach and Henley Beach hostage to political games and conflicted decision making! Get on with a long term solution and finish the pipeline solution. It's been very successful on southern beaches
Why not ask about other options?
I would much prefer an environmental/engineering solution whereby the sand doesn't deplete from West Beach. surely something can be done with rock walls and groins to ensure the sand is more stable.
Why is it that Government remains blissfully unaware that there is a Policy "black hole" in relation to the management of the River Torrens? Authorities have been appointed as responsible for most of the river system, from the Adelaide weir to the weir at Henley Beach South. From the weir at Henley Beach South to the sea, THERE IS NO RESPONSIBLE AUTHORITY and therefore no advocate nor budget for the essential management of this area and the "stockpile" of sand that naturally occurs.
Perhaps groins could be positioned along side the existing jetties and then extend the jetties to deeper water where you can fish, swim and enjoy our coast.
The groins would be designed to compliment the coast line and be extended together with the jetties out to sea as sand builds.
Very hard to find a perfect solution. You can't stop nature without serious consequences.
As proven when you look at the North Haven Marina and the massive build up of sand to the south and the same for the southern Outer Harbour breakwater where the sand is now getting close to the top of the rocks.
Governments and councils rightly spending serious amounts of money by employing highly skilled consulting companies and researching world options.
Unfortunately I do not see any innovative solutions listed in this paper that will not be a never ending massive financial drain. There must be other examples in other countries that should be explored.
Putting this list of questions back to the uneducated public for their sometimes very biased opinions is unlikely to be helpful.

Looking forward to your advise on some innovative solutions.
Cheers
Peter Cooling
Anything to get the sand pumping unit off the beach
Please stop the sand drift from south to the northern beaches. Why not use the system currently in use along Somerton beach, Sandbag groins.
The problems of west beach are not the problems of Largs residents. How about the wealthy residents of that suburb and their council just sort out their own problems? Ta
Why not just add more "artificial reefs" or
causeways in between existing jetties as per the definition of a causeway ... That is ... A causeway is a track, road or railway on the upper point of an embankment across "a low, or wet place, or piece of water".[1] It can be constructed of earth, masonry, wood, or concrete. One of the earliest known wooden causeways is the Sweet Track in the Somerset Levels, England, which dates from the Neolithic age.[2] Timber causeways may also be described as both boardwalks and bridges.
That would be able to create small bays and boardwalks ... etc.
Cheaper in the long term ... and added infrastructure that is environmentally sound; aesthetically and enjoyable to use; provides permanent employment and can be micro managed easily ... and would work out cheaper in the long term .. with simpler deliverability, less / no environmental carnage, not a political / community divider-er and little environmental marine decimation.
please take the trucks off the roads where they are destroying our environment, contributing to global warming, and endangering our kids and our lives.
I am very surprised that for such an important issue that the discussion paper and the survey are not aligned. I am also surprised that there is not an option that involves offshore pumping into a pipeline without the need for any truck distribution or dredges. Either way the option selected MUST NOT involve trucking on the beaches.
Please listen to the people as you have requested their feedback.
Stop wasting money again going through another review the local residents have had enough, we all know what the right thing to do is here to protect our shoreline so just bloody do it!
No pipeline, no sand carting, no dredging, no trucks, no excavators, no collection units, no pumps and no scrapers on Semaphore and Largs beaches. These will cause a massive environmental impact for the northern beaches.
Minimise trucks coming through our club precinct, a risk to our junior members, ruin of our hospitality business and generally creating havoc in our club environment.
Stop changing the natural coastline
I question the futility and ongoing expense of trying to intervene in a natural, dynamic system of Northerly sand drift. Houses at West Beach, Tennyson, Brighton and Somerton should never have been built on the sand dunes.

the best solution would be to move all development a few km inland from the shore, and rebuild the dunes to their pre-European state, like at Largs North and Tennyson. It's the only thing that stands the test of time.
If this happens all the time where is the sand going? The sand has to be going somewhere wouldn't you put studies in to find out where it's going or work out a way to prevent it from going
This review is appreciated to find solutions to protect Adelaide beaches from further erosion. Thank you
There is precedence in other jurisdictions that the build of a pipeline greatly impacts local house values and community - there will need to be compensation for the residents of the area if you decide to build a pipeline and I"m not sure you can afford that.
Dredging from off-shore or near the shore to the shoreline seems to be the most economical, environmental and people friendly sensible option
As noted in my previous responses, I'm concerned pumping sand in a long pipe will be more difficult than expected. Pumping water long distances is challenging, pumping sand will be even more difficult. It will eat through pumps and wear through the pipe; blockages are inevitable. I foresee another "infrastructure embarrasment" - did SA learn nothing from the "one way Southern Expressway" debacle?
Dredging is clearly best option,
Detailed Environmental impact statement required prior to commencement of dredging especially Bird Island Sand Bank.
Further options to reduce flow of sand from West Beach should be considered.
I am curious as to how much this survey is going to impact on the decision making process.
I think the least impact is to dredge and pump
Then have sand retention such as sea cliff wheretherewas little sane 50 years ago
Need to stop making this political and get the best result which is option 2.1 . We all know this works
As someone who has lived in West Beach and then Semaphore for over 60 years I can see that climate change is escalating and major erosion is being caused to all of our beaches. This will only get worse and could escalate quickly if the number of storm surges continue to increase as they are. Dredging looks like like the best option at the moment as it is the least harmful, cheaper, and an adaptable and flexible system for both the sand source and depositing. We will need to be on the ball with clever heads around the table to continue developing dynamic monitoring systems and also to continue looking for other solutions. dredging is not perfect but its the best option at this stage.
I was pleased to note that the review has been limited to re-examining the methods for future beach replenishment, rather than re-visiting the various structural options, as canvased in previous reviews. And I support the idea that there needs to be a combination of bringing in new sand as well as redistributing existing supplies. I am disappointed that public discussion will be confused by the inclusion of options which are clearly not valid, such as use of submersible pumps on jetties and small/medium dredges in the nearshore zone, and the failure of the consultants to point out that the

offshore sand sources that they refer to have previously been shown to be unsuitable. Public discussion of invalid and hypothetical options would not seem to be useful.
This subject has been studied for the past 50 years. It is time to do something about a sustainable and acceptable solution.
I think the key info that is missing is a full environmental assessment of the options. Public can't be expected to sway the decision when all the information they have is based on money and disruption to beach use. We need info on sustainability, impacts to marine ecosystems, energy use, long term chance of success. Money could be better spent on improving conditions near the coast, restricting development and improving storm water to improve seabed health.
Investigate root cause of development on West beach sand loss & address. I.e. if marina/development is causing issue of sand drift bypassing west beach, it should be reversed or paid for at this end.
Nope
Message to the Premier. Susan Close cannot be trusted on this issue.
Leave the northern metropolitan beaches alone! We have endured sand carting and trucks on our beaches for years which has severely impacted the amenity and use of the beach and given rise to safety issue for beach users, families, children and dogs
This is a hard question to be answered as the sea grass beds are critical to the health of the local waters and these should be front and centre of any impact assessment
Now that the path from Semaphore to Tennyson is being finished the option for a pipeline and pumping stations is out. trenching through the sand dunes and beaches will be forbidden. Mother Nature at the end of the day will win, all solutions are flawed, the best option will be dredging in front of west beach which has te least impact to the beach community and the environment.
Recycling of sand from the northern beaches is the only viable option. We cannot continue to feed sand to the northern beaches by drift without bringing it back to where the drift commences. The pipeline from Glenelg to Kingston has proven to be a complete success and should be adopted now to resolve the sand loss issue.
This should have been implemented BEFORE the destruction of West Beach, Henley Beach South & Henley beaches. It isn't new knowledge.
West Beach SLS has been dealing with the lack of sand for many Nipper seasons, disrupting our kids enjoying their surf season. Sometimes there isn't enough sand for the Nippers to do a full sand session.
Something needs to change and quickly or the local surf clubs won't be able to function to their full capacity due to lack of beach. The locals would love the return of the dunes, and the wildlife that depend on the dunes would benefit from a replenished habitat.
We should use proven technology, dredging should not be an option due to the environmental damage to sea grass and the overall carbon footprint should be considered for all options , over the projects lifetime.

I want to see a better outcome for West Beach but certainly not by destroying Semaphore and Largs Bay and the local coastal ecosystem to get there, which is what will happen with a pipeline or with carting of beach sand alone.
Adelaide's beaches are some of the best in the world. I've seen many of the others. Their natural beauty is not man-made. There are much more effective, simpler, inexpensive strategies that can suffice to support them, such as the ones introduced in the 1960's-'70's, with permapine posts, shade-cloth and marram and other grasses to consolidate the dunes thus created.
Collecting from the beaches is not working for either beach.
The survey has provided an extremely narrow set of options, without clear definition of any constraints and/or limitations from the larger set of options being defined. For example, were financial, environmental, community, engineering/design limitations set to short list to these three (3) options?
The offered solutions lock the community into a continued financial commitment that does not 'solve/stop' the problem.
My overall preference is to address the root cause of the issue (Climate Change, Increasing Storm Damage and Wave Movement) and create an artificial reef or breakwater ~1km offshore. Addressing the cause(s), not the symptoms is my strong preference and I firmly believe the Government,Department and Consultants have failed to adequately consider, address, document and communicate these.
BY ANALOGY.....(and please stick with me).....RATHER THAN COMMIT TO A 20 YEAR PROGRAM FOCUSSED ON REACTIVE MEASURES LIKE PICKING UP CIGARETTE BUTTS FROM THE BEACH AND TREATING PEOPLE FOR CANCER CAUSED BY SMOKING (A PROGRAM THAT WOULD ALSO HAVE ADVERSE FINANCIAL, ENVIRONMENTAL AND COMMUNITY OUTCOMES), HOW ABOUT WE CONSIDER A PRO-ACTIVE MEASURE LIKE MAKING CIGARETTES LESS ATTRACTIVE FINANCIALLY AND/OR BANNING SMOKING COMPLETELY AND ACTUALLY STOPPING THE CAUSE(S) OF THE PROBLEM.
My overall preference is NOT to Dredge OR use a Pipeline - both are reactive measures that do not solve the problem. How about we target a solution on the cause(s) of the actual problem?
It is disappointing that the Review had a restricted budget that did not allow a deeper dive into what is needed in terms of management. There are no 'solutions' that will be magic bullets in such a dynamic system that has already been managed for decades. In the long run, can we extend dunes out in front of our built up Esplanades to provide a natural buffer?
I have done considerable research on sand management options and have experience in the challenge of developing Engineering solutions in a maritime environment and given the complexity of beach management and the diversity of views, opinions and lobbying by various groups for a plethora of options, the options and cost estimates seem reasonable. One area which could be expanded is an assessment of the coastal protections that could be afforded by a robust campaign to restore coastal seagrasses.

Having lived for years with sand carting on Semaphore beach it is a nightmare heavy haulage trucks running quite quickly continuously up and down the beach for months I am surprised no one has been killed
Acknowledging the desire to protect the southern beaches the dredging options are clearly best for social environment (subject to EIS) and cost
However I predict option 3 will continue Why ? Because it's easy to implement and there is no government commitment to environmental or social issues just rhetoric
Can you contemplate the outrage if this machinery was running up and down Glenelg it Brighton beach continuously for 2-3 months twice a year
Let's start living up to the rhetoric of Adelaide being a world class environmentally and socially responsible city by a commitment to a long term solution that does not involve trucks and excavators and loaders on the beaches
Summary. Firstly the survey was quite confusing when using the technical data to get more information about the options as the consultation options didn't directly relate to the numbering of the options in the Draft of a Draft technical data report. Unnecessary cross referencing needed to be made to ensure the correct information for each of the options.
Disruption to all communities
When comparing all options under the goal of minimising disruption to all communities, the Dredge options clearly meet this criteria in 1.1, 1.2 with minimal disruption in option 1.3, while the trucking options meets this goal only to a limited degree impacting a number of communities. However, the pipeline options fail this goal on every level not just in the construction and installation of the pipeline but the ongoing maintenance & operation of 14 kms of pipeline. Many communities will continue to have their beach amenities degraded by hard permanent infrastructure and heavy, noisy machinery of their beaches. Largs Bay and Semaphore, two very popular tourist and visitor destinations will see their beach's amenities severely impacted which will affect not only communities but also businesses which rely on visitors. The pipeline's inability to provide the right amount of sand, the right composition of sand to the most effective position for maximising sand staying on the beach will result in the need for trucking additional sand, causing continued disruption to the recipient beaches. All of the pipeline options cause significant disruption to the historical and cultural landscape of the Kaurna people.
Avoiding environmental harm
Option 1 -The Dredge Options is the most effective option at avoiding environmental harm. The sand source areas of dredging options will be subject to an environmental assessment and approval. The impacts of dredging activity will require a range of environmental management activities including turbidity monitoring pre-and post- dredging seagrass surveys during the works. With these strictly monitored requirements the dredging options can be done effectively with little environmental damage.Restoration of impacted seagrass areas has the possibility of being restored after the completion of works. (The monitoring of seagrasses adjacent to the recent large Port River channel expansion showed no long term damage.)

Option 3 -Moving sand using trucks and machinery has shown damage to the environment at the sand source sites. Thirty metres of shoreline has been lost at Largs Bay, while 70 metres has been lost at Semaphore between 1988-2022. With impacts of climate change including more frequent storms, higher tides and sea level rise the protective dunes have not recovered from sand collection activities. Future sand collection works will likely result in further erosion putting the infrastructure they protect behind them at risk of inundation.
Option 2 -All three pipeline options fail the avoiding environmental harm goal.
The previous Development Application of the shorter 10 km Semaphore to West Beach described many possible environmental risks, including to marine and beach ecosystems, regulated trees, the built environment, including heritage structures and infrastructure. The addition of billions of nano and micro plastic particles from the abrasion of the now 14 km HDPE onto our beaches and into our gulf waters is irreversible and comes under Section 5 of Environmental Protection Act's definition of environmental harm caused by pollution (including micro plastics) and the impact on health. The cost of the wide ranging and long term harm to Adelaide's beach and gulf environment far outweighs the minimal benefit that an ineffectual pipeline may deliver. The false comparison of the Glenelg to Kingston pipeline as a successful example of pipeline technology has failed to take into account the 1.2 million cubic metres of very coarse sand delivered into the system prior to the pipeline's operation. Even with this coarser grain size there is now issues with fines being caught in suspension and plumes which can extend beyond 200 metres off shore. It also fails to recognise that Kingston & recipient beaches are situated in a protected bay relatively sheltered from prevailing SW winds and strong wave action. It has not factored in on going need for the maintenance of pumps, operational costs including replacement of pumps. One entire section of the pipeline, running from Glenelg to West Beach was decommissioned due to damage done to the coastline.
Maximising sand
The Dredge Options providing a mass nourishment of sand to the near shore, allowing nature to build up a healthy beach profile provides the optimum conditions for maximising sand staying on the beach. . International research and examples demonstrate the success of this technique. Whereas delivering sand to the beach face, where both the trucking options and the pipeline options will be delivering sand, has the effect of steepening the beach face resulting in sand being eroded more quickly.
Taking high carbonate, smaller grain sized sand from the northern area beaches and transporting 14 km through a pipeline will further reduce grain size, resulting in sand being eroded off the beach more quickly with very fine sediment plumes causing potential problems for seagrass regeneration. Both Option 3 and all Option 2 pipeline options fail at maximising sand staying on beaches due to placement and inferior grain size and composition.
The Dredge Options are the only options that are suitable for sustainability and maximising the sand remaining on beaches.
Cost and Climate Change Impacts
As we are seeing climate change make impacts on all our South Australian coastlines resulting in receding shorelines and erosion of dunes, there will be competing needs for limited tax payer

funding in remediation and securing of our coastlines. It is crucial that a cost effective measure is chosen in Adelaide Beach Management - one that gives the tax payer good value for money. The Dredge Options are the most cost effective, least likely to do environmental harm, least disruptive to all communities and have the most likelihood of the sand remaining on beaches, building up healthy beach profiles and contributing to dune growth which is necessary as we see an increase in climate change impacts. The Dredge Options are very viable options and should be considered going forward.
However, the Pipeline Options are the least cost effective, most likely to do environmental harm to the built and natural environment, most disruptive to most communities and the least likely to have sand remaining on beaches. The pipeline and trucking options will result in the lowering of sand source beaches at a time when they should be being bolstered. As such the Pipeline Options and Trucking option do not represent good value for tax payer dollars and therefore should not be considered as viable options going forward.
Please do something. Stop the endless reports and investigations. This had been looked at before. The beaches are disappearing so please, please do something!
The science around mining sand from Adelaide's eroding beaches is clear. Ongoing carting from sand mines is expensive and invasive. If offshore dredging is viable if it collects the right grain size sand, doesn't affect fish and seaweed stocks and does not harm beaches further by changing the wave pattern affecting shore erosion.
Creating off shore artificial reefs, or potentially sandbagging, are alternative options.
I visit the Semaphore and Largs beaches every day and see the impact that sand scraping and carting is having on the stability of the beach sand and the erosion of the dunes. Keep your trucks off these beaches and find an alternative solution. Quarry sand, recycle glass back to sand, or dredge deep off-shore at the beaches that require sand replenishment. Stop destroying suburban beaches to fix another.
I hope the solution utilised will take into consideration the environment, visitors and the local residents. This is not just a monitory issue.
A combination of approaches is more likely to be successful. Any implementation must be carefully monitored, assessed and continuously evaluated. Local governments have significant resources, expertise and experience in coastal management yet have not been engaged in the review process in a collaborative process, or in any meaningful way other than providing submissions. The whole process is such as to exacerbate the divide between coastal communities. There has been no serious attempt at bringing the various groups to the table where facilitated discussion could work towards a collaborative approach. The Chair of the IAP asked everyone "to be nice to each other" whilst presiding over a process that divides us all.
why is there no option to excavate sand from the northern beaches and pipe it underground back down south, as was approved by the last government. It made sense. It works between Glenelg and Seacliff. Why is this option not in the survey? This is the option I support. That is the only option that works.

Grow more sea grasses or reefs to hold the sand in place.
Make a start by removing the West Beach boat RAMP,not a HARBOUR,a RAMP!!
The gouge in the coastline adjacent to the West Beach Tourist Park is being caused by that Boat RAMP which in turn affects West Beach.
Save our beaches. It is simply a disaster that this situation has been left and the results are showing.
Disappointed that options such as slowing down the rate of sand movement and wave reduction have not been discussed as long-term strategies.
I don't believe a pipeline is worth even trialling.
Sand diameter is important as is its placement (likely not onto the beach but slightly offshore), maybe where the sandbars and seagrass used to be located historically.
I have seen the dunes retreat and their sloped edges become little cliffs after sand carting, which destroys the natural growth of plants and creatures.
All of these solutions are avoiding the real problem, the fact that in southern areas the urban development has encroached too far onto the sandhills and beaches. The much longer-term plan should be addressing this, via a buyback scheme or similar so that the properties, roads, infrastructure under threat are relocated. The northern beaches have not suffered this encroachment, so should not be compromised as part of a short-term solution. There is also no option presented of building walls or groynes along the beaches to minimise the northwards migration. It should be acknowledged that the core problem ultimately cannot be addressed by what is essentially short term "cosmetic" solutions. We should consider what people in 50 years' time will think about the actions that we are planning to take now. They will thank us for a more permanent solution or make fun of us for pouring what will end up being endless amounts of money into a short-term fix.
Firstly, I'm unsure why this is even open to community consultation. This should be based on a science-led solution to fix a man-made problem. Unsure why the community lay-person should have a say? By your own admission, you advise that this will not be based on numbers or popularity. Nor should it be. This whole issue has become politicised. And as a result, equality in coast coastal management has been dismally lacking. This process has only increased division between central and northern beaches. I hope hope the difference in argument has been duly noted. The Northern beach people spruk a "no trucks on our beaches", "don't take our sand", "only quarry sand" stance. The central beach people just want sand. They have been agnostic in terms of political party or solution. And have always demanded that science should be at the forefront of any solution. But when delivered with the options from the current review, there is only one stand-out option (pipeline option 2.1) which seems to be both practical and proven based on existing working models, with the ability to be implemented without all the unknowns (eg dredging viable sand source, EPA approvals, environmental impact studies/assessments). Let's get on with it.
Inadequacy of the process in providing any credible scientific analysis of the options. Any choice made on this basis is inherently questionable at best. In addition, the process fails to acknowledge:

the need for complementary measures to retain sand as much as possible.
any implemented option(s) must be regarded as a trial and continuously monitored and evaualated
I suspect that some of the sand issues have been made worse by man-made off shore structures that interrupt natural sand flow. If this is true, should we look at removing these rather than chasing our tail with more intrusive behaviour.
The sand management programme at Brighton is working really well, at long last. The sand is of the right consistency, the groynes are helping to retain it, sandbars are reducing wave impact. The slumping of the rockwall north of Brighton jetty has been temporarily attenuated, but will need to be addressed in the future. the northernmost groyne at Gladstone Rd needs shortening and lowering to reduce erosion of Minda dunefield. The pumping programme has minimal impact on beach goers. Well done!
Agree that Adelaide beach sand needs to be managed. Strongly support moving sand from northern beaches back to replenish southern beaches in the most cost effective way (which may change over time). Do not support using quarry sand which is just going to add to the sand build up along the northern beaches.
I favour a combination of continuing existing pipeline sand movement with fixed pump stations, and added quarry sand.
The underwater environment should be protected and not ruined be dredging activity.
West Beach and Henley are so bad now we cannot nominate to have surf carnivals anymore. At West Beach we have over 200 nippers who need a beach. We have over 400 active members who need a beach. The health of the community relies on these beaches. We need a whole of coast approach. We need to share our precious resource of sand.
This is an opportunity to ensure we preserve our beaches for future generations. Current practices and most of those proposed here are not environmentally sound and we need to ensure that long term solutions and not quick fixes are employed. As we can see from the destruction of Semaphore beaches since the trucking of sand commenced if continued we face ruing another beach alongside those like West beach already compromised by poor government decisions
I have lived here for 14 years and walk on the beach most days. I know from observation how much coastal damage has occurred from storms and sand mining. We have lost important breeding sites for red capped plovers at Semaphore Sth. This area is very slowly recovering but will be destroyed forever if the pipeline goes ahead. The sand from our northern beaches is too fine for West Beach and is washed away at the first storm. A long term, cost effective and environmentally friendly solution is the best way forward.
Please do the least environmentally damaging which I think is dredging sand and each season find different locations
Sea groins will stabilise shorelines on central beaches. Taking the already 'returned' sand from Semaphore is a costly, impermanent and pointless exercise.

Esplanade properties will soon become waterfront residences with boats, not cars as their mode of transport.
Mostly this idea of replenishing a beach on a temp basis and spending, no WASTING, millions of dollars on sand is absurd. The kowtowing to a handful of residents (in the scheme of the greater population) is financially criminal. Keep your hands of mother nature and her beaches and what will be will be. Leave it alone and leave it be. Save the money for when the real issue of ocean levels rising starts affecting suburban beaches and houses. Do Not Waste Money when children are dying and people are starving and homeless. Absurd
Please don't take sand from Semaphore and Largs for West Beach, there are clearly alternatives such as offshore dredging (which is also the cheapest option) so dredging is a better choice than a pipeline or trucking from the northern beaches.
Review has not addressed full issue. It killing of sea grass by water in flows increasing sand drift along coast. Only option is pump as Glenelg to Brighton.
Semaphore beach and Semaphore South have been losing sand since the construction of the groin. No-one seems to acknowledge this fact, my question is : what is the point of destroying another beach to save West Beach, all our coastline will be affected by rising sea levels: any strategy needs to take this into account.
Will to appear before committee w/ work I have done for Cmb since 1989. Historical background n why
I just hope that the powers that be make the right decisions to protect our environment by listening to our geologists and following their advice.
Restrict sand drift North. I don't know how as thats not my area of expertise.
Best if breakwater/ and other structures hadn't been built in the first place where they were or at all. Short sighted and reckless.
Option 1 is good fabulous... Lets keep pipes collection stations cranes excavators and trucks off our beaches jetties and local roads..roads in general.
Whilst all beaches need conservation, the beaches of Semaphore, Semaphore South and Largs Bay are the "Local" beaches of not only nearby residents but all for all of Adelaide who live north of Grand Junction Road. Impacts on beach use and enjoyment for these beaches should be avoided.
Just pump the sand from northern beaches like lugs and semaphore back to West Beach. Simples
Please look at the statistics
The damage caused to semaphore & semaphore south areas is incomprehensible .
There are options to cart quarry sand
Keeps people employed
Keeps out beaches usable and had no impact on the environment negatively .
Keeps beaches open to public to enjoy in safety and Keeps local business surviving through continual traffic .

Sand carting has totally changed the semaphore & semaphore south coastline negatively .
Please stop the trucking
The disruption
The noise
The impact on caravan park travellers. Surf community & those that love the reserve
Yes. I earlier filled out a survey, regarding this issue, that was the the worst survey that I have ever seen. It asked ridiculous questions that no-one could possibly answer correctly. I hope that you have received much feedback about this, and will disregard the results of that survey.
I sincerely hope that the decision that is finally arrived at will be made using scientific knowledge to cause the least amount of harm to the beach environment, whilst solving the problem, and using plain common sense, and not made by listening to the loudest voices. These voices may well be loud and passionate, but may not offer the best solution for all of our beaches and beach communities.
There may not be one clear answer to the problem, and we may need to put up with inconvenience, but the beach must be kept in a healthy balance, and not just have extra sand delivered to it.
The cheapest option may not be the best option. Adopting the pipeline option, because it's "already in the pipeline" would be a lazy decision. Our beaches are too fragile and precious to withstand the degradation caused by a pipeline.
My local beach at Henley is two metres lower than it used to be. A sensible decision needs to be made quickly and acted upon.
Appreciate the problem and how we have ruined the natural equilibrium and need to intervene. Always going to be NIMBY responses to a challenging situation. I also appreciate the thought put into the options and community consult. I trust the coastal environment experts to make a well balanced decision, based on their knowledge and consideration of cost , that suits to greater good.
The need to use current, relevant data when selecting the best option is paramount. We need to invest in Lidar and take note of other up to date data. Many of the cited references were prepared years ago, and with the acceleration of climate change, we need our proposed actions to be based on the latest scientific data.
Henley Beach is in need of an immediate injection of sand to prevent the rock-wall being undermined and public safety and infrastructure being put at risk.
For far too long West Beach has been neglected and starved of sand.
Experts warned that if West Beach wasn't brought into equilibrium, with a mass replenishment and on-going nourishment, then the speed of erosion would accelerate, and the beaches further north would experience the same outcomes. This is now a sad reality and one that could have been avoided with effective coastal management.
The severe erosion problems at West Beach are unfortunately the result of man-made intervention:
The construction of the boat harbour and Holdfast Shores in the 1990's marked the beginning of the interruption of long-shore drift, but for unknown reasons, despite being cut off from long-shore drift

West Beach was then mined some 1,000,000m3 of sand to nourish beaches both to the north and south (1997-2016). To make matters even worse despite losing approximately 115,000m3 of sand per year, no replenishment of sand was brough back to West Beach during that time.
How was this allowed to happen?
For too long there has been a lack of care and equity in managing sand at West Beach, and the resulting problems now experienced at Henley Beach South and Henley Beach, (Central Beaches).
The cancellation of the pipeline in 2022 has had devastating impacts on the Central Beaches. The beaches missed out on the mass nourishment and were drip-fed amounts of sand at a time which resulted in the beaches being kept in an eroded state.
There is a clear lack of equity in managing sand delivery too. Whilst the ABMR was underway there was an embargo on taking sand from any metropolitan beaches – yet no such embargo was applied to the Central Beaches. Despite being 90,000m3 in deficit, sand was scheduled to be mined from the Torrens Outlet, in winter and forward passed to Henley South. This not only went against science, but it also had no modelling and displayed a distinct lack of equality in the care for all our beaches.
Now is the time for equity and for treating our beaches as one coastal system.
The on-going review has opened a ‘social war’ and created an “our sand vs your sand” mentality and has sadly become a political pawn - “red sand vs blue sand.”
Our beaches cannot be treated based on electorate boundaries – the Government of the day has a duty of care to protect the entire South Australian coastline, not those who have won the geographical and political lottery.
We have seen the formation of many different special interest stakeholder groups, many of whom claim to be experts, and claim to be representing a specific area.
What we need are holistic solutions for the future of the entire coast, based on science, facts, equity and fairness. Our beaches and dunes need to be looked at as one system. The health of one section of the coast or dunes has direct impact on the health of another. If all beaches are healthy and in equilibrium, they are more resilient to storms and events and likely to be more self-sufficient, and less likely to cause problems further along the coastal system.
One of the considerations of the review is to “minimise disruption for all communities”. How do you quantify the term ‘‘disruption’’ – for one community it may mean not having trucks on the beach, for another community it may be not actually having a sandy beach at all.
The pipeline is the only method which has a proven successful track record. The designs and approvals are already in place.
Dredging has no such approvals, or proven efficiency for conditions specific to Gulf St Vincent.
The identification of a sand source, analysis, modelling, and necessary approvals will take years. The Central Beaches do not have the luxury of time. The longer the delay in an implemented solution, the more risks for the Central Beaches, as both erosion and cost escalation.
An article in The Advertiser, January 2nd, 2014, stated:
"A 1997 plan to bring sand back to rocky Hallett Cove appears to be dead and buried.

A Department of Environment, Water and Natural Resources spokeswoman says sand replenishment is not a “viable option” for the beach.
Sand replenishment looked likely after a 1997 State Government report recommended the beach receive replenishment, but the report was never acted on."
The last paragraph of the same article also stated:
"Last month sand was restored at Kingston Park Beach through the State Government’s $25m sand pumping pipeline, which aims to replenish sand between Kingston Park and the River Torrens."
https://www.adelaidenow.com.au/hallet-cove-no-longer-in-line-for-state-government-sand-replenishment-plan/news-story/9a5e05fb5960fdbf92b8869977028939
West Beach, Henley Beach Sth and Henely Beach cannot be allowed to become the next Hallet Cove.
The jetties are a source of relaxation and recreation all year round. it is not right to close them for part of the year and make them inaccessible let alone the negative environment impact to the local beach
Thank you for doing the research & involving us. Can't begin to imagine how hard it will be to come up with the right strategy but take heart from others who say there are some good people on the job - thank you and good luck.
Everything about this is WRONG. Think about the environment and communities you will be ruining by proceeding with removing sand from semaphore.
I am disappointed that so much consultation on 'the future of 'Adelaide beaches' and supposed discussion of long-term solutions seems not to consider solutions for damage to any beaches other than for West Beach and Glenelg. This is all very short-term focussed and very short-sighted use of time and money.
Quarry Trucks have no regard for beachgoer safety. Too many close calls.
Questions 13, 14 and 15 do not display correctly on a iPAD with latest OS
Dredge large grained sand from Pt Stanvac or the Murray mouth. Deposit near shore in large volumes on the southern Adelaide beaches. It only needs doing once every tens years or so. Cheaper in the long run with much less disruption and will benefit of all Adelaide beaches and beach users
Do not take sand from Largs Bay and Semaphore, it isn't sustainable! No trucks and machinery on beaches! No pipeline!
There has not been and environmental impact study’s done, if there has the information is being withheld
Please do not ruin our beaches in a fruitless effort to save another beach. Please find a sustainable method that allows all of us to continue enjoying the beaches we love
Adelaide's beautiful beaches are one of our best assets and too important to lose. The state government should be prioritising building a more resilient coastline because Adelaide’s beaches and their dune systems are the frontline defence against the impacts of climate change. The solution

needs to have inbuilt flexibility in order to adapt to the unpredictable future impacts of global warming and subsequent rising sea levels.
Our government must also heed the latest research on the insidiousness of microplastics and work to reduce them in our marine environments. This entails not installing a 10km plastic pipeline which gets abraded by the sand slurry to half of its thickness. This abraded plastic ends up in the Gulf St Vincent and our food chain.
I think dredging is the most flexible option and can be adjusted to deliver the sand to where it is most needed, both now and in the future.
Thank you for the opportunity to have input. I would like to see the option of Murray Mouth sand considered, which is already being dredged. If the coast is losing sand overall then we need to look at options for increasing sand along the coast, not moving it from one area to another and damaging the seabed or coastal environment in the process.
A cognitive map of critical issues in a recent Dutch review of dynamic coastline conservation published Sep 2023 present a very complex system. However, dealing with this complexity suggests an incremental approach with continual monitoring of progress is needed. The dredge options provide the best way to address this.
It's somewhat perplexing that the reason for the state of West Beach is not being looked at - developments including the Boat Ramp have caused this situation yet that's not on the table to be considered.
Climate change is accelerating and this must be considered when looking at the viability options.
The sand at the Murray Mouth must be considered as an option.
Micro plastics and Nano plastics from the pipeline options are pollution and Environmental harm as defined by the Environmental Protection Act (SA).
There are modern dredging guidelines which ensure that the Environmental Protection Agency overseas dredging.
Wave action and loss of sand can be lessened by increasing sea grass in and around those beaches affected by erosion. We need to consider additional resources in the building up of sea grasses in these areas.
Mass nourishment offshore from a depleted beach has been proven to be very effective.
Environmental solutions are important.
Finally, flexible solutions are the key. A pipeline is the least flexible.
1. In supporting the options using dredging (and not supporting using on-beach heavy machinery, jetty-based pumps or a pipeline with its pumping stations), I also support professionally conducted Environmental Impact Statements on the dredging option(s) that ends up most favoured, including assurance that the Section Banks and North Haven deposit will not be seriously adversely affected.
2. Although well-qualified people have proposed that sand already being dredged at the mouth of the River Murray could be a viable source of sand for West Beach, I note that this option is not discussed in the present paper or survey and wonder why.

3. Many thanks to DEW for the opportunity to participate in this survey. It has been a relief to receive valuable up-to-date information and presentation of some sane options through the current independent research and advisory process.
Why can't we just stop the sand migration by creating articulated reefs barriers
Why spoil more beaches to save others. Please use methods which do not spoil more beaches.
Please take into account the likely impact of global weather change on all our beaches which will put all beaches at risk. This is another reason to avoid disrupting more beaches
I am so very concerned about the negative impacts to my community regarding the pipeline or sand carting. I am proud to live in the City of Port Adelaide Enfield which supports dredging and does not support under any circumstances a pipeline or carting of sand,
It feels like beach communities have been pitted against each other in a fight for lost sand. ALL the beaches need to be managed and nourished properly, so that all the beaches can be retained for the future.
Thank you for the opportunity for feedback.
For the source of sand, it's important that an environmental assessment is conducted to ensure a limited environmental impact and a good monitoring during the operation
I have sent a separate submission
None of these proposals look to be permanent fixes.
I think you need to stop listening to the noisy minority groups and let the experts manage this.
The pipeline is the less intrusive option hands down. It is the most environmentally friendly option. It carries the least amount of carbon footprint, please just get on with it.
I believe sand already being dredged at the Murray Mouth is a viable source of sand for West Beach. Could this become another option?
Thank you for the opportunity to contribute to this survey.
Please consider the huge environmental impacts of the dredging and pipeline options. The biodiversity of Largs beach should not be at the expense of West Beach. West Beach deserve a solution to this issue but taking from another beach is not it. Quarry sand to a port near the beach, with minimal trucks on the beach at any time. Also consider implementing more gabion walls to prevent damage to property assets.
Pipeline is terrible idea. More disruption to people and the beach. Dredging sand and letting nature do it's work is best
The largest perspective on the coastal environment should be taken, and one solution should not create more problems.
In short the 'Coastal protection practices' over the last approximate 50 years have been abysmal, costly and destructive. Department heads that have lead, approved and been responsible for construction of damaging breakwaters and that have in the short term(15 years) created further

damage to our metropolitan coastline which in turn created monumental envirvonmental decisions they are now and previously unable to solve.
Preference is dredging as the cheaper, more flexible option with less environmental impact. Strongly oppose the pipeline due to environmental and community impact, and associated costs.
Please do not remove sand from our local beaches, the methods being used are band aid and do not address the problem adequately for a whole of coastline approach. Also we are not lesser beaches to be used to prop up Glenelg West Beach etc. We vote and pay council rates, be careful.
This process has not been transparent and options have not been researched and described in adequate detail for residents to make informed decisions. There have been several requests for more information to be made available and this has not been met with support from the authorities.
My partner and I both wish to register the same vote, but she does not wish to join Facebook, so wondering if future surveys of such an important nature could be conducted online but without the necessity of joining Facebook?
This issue has been a persistent point of concern for the City of Charles Sturt and the local beach side communities, there must be more joint cooperation between government and council on a solution. This issue is pervasive, and erosion happens fast. The local community has an in-depth understanding of these issues as does the City of Charles Sturt Council. Solutions driven through localities such as the council should be front and center.
The pipeline is the most costly and environmental damaging solution. Do not support
As a geologist who became an accidental politician, my primary focus is safeguarding Adelaide's northern beaches from outdated management practices and the risks of climate change. I currently serve as the Councillor for Semaphore Ward within the City of Port Adelaide Enfield.
My community has watched in dismay as plans for a West Beach to Semaphore/Largs Bay pipeline have unfolded, along with witnessing the devastating consequences of sand quarrying on Semaphore and Largs Bay beaches. I'm grateful that BlueCoast Engineering has suggested an alternative option – dredging (mass nourishment) – for beach management in Adelaide.
A simple stroll along our beaches reveals a stark reality: our northern beach system is receding. Despite contrary claims, current data and physical evidence paint a picture of coastline recession and landward retreat. Modern federal satellite imagery shows an average loss of 5 meters per year from Semaphore and Largs Bay beaches since 2016. Semaphore alone has lost up to 70 meters since 1993.
The quarrying of northern beach sand for carting or input into a pipeline only exacerbates these environmental issues and will cause harm to the community in numerous ways. This includes compromising public safety due to truck movements on beaches and excavations on the beach and intertidal zone. It also impacts local businesses and public amenities, with noise, emissions, beach closures, and other nuisances. It creates the potential for environmental pollution by creating nanoplastics from a quartz slurry being pumped in a plastic PVC pipeline. Additionally, it harms the natural environment, eroding coastal habitats and accelerating coastal erosion, which, in turn, could affect infrastructure and properties.

A new, sustainable approach to beach management is imperative. We need an adaptive, cost-effective approach. One that minimizes community impacts and has a track record of success worldwide. Dredging is that approach, and I wholeheartedly endorse it.
I am all for repairing West Beach and any other beaches that require repair and or sand replenishing BUT not when it damages other beaches to do so. The beaches are there for all to enjoy from all different areas.
Henley Beach is in dire need of sand replenishment now. Rock walls are undermined, dune vegetation is dying and has roots exposed. Access points have been closed for some years now. The situation is unacceptable to what was once a beautiful beach.
Only that if all artificial man made structures were removed from the shoreline...ie the marina and groins...we probably wouldn't have this problem
Man-made solutions are indeed often necessary to address issues caused by human activities, such as coastal development. Finding a balance between human infrastructure and natural coastal processes is crucial for the well-being of both the environment and the community.
Must be supported for sand to be recycled.
We cannot keep filling the northern beaches with sand without recycling.
Regrettably-Fails necessary mass fill needs.
No Govt can continue to fill the Northern Beaches without recycling sand.
Quarry sand is far too expensive to be sustainable.
Choosing this option sadly generates ongoing significant disruption with trucks working at source, on roads and delivery destination.
Wrongly has ongoing continued disruption embedded into the future of West Beach
Please do not continue the destruction of our central beaches!
The long term safety of our beaches needs permanent infrastructure to support it.
The initial costing will protect our beaches into the future. The pipeline options are the only way to achieve this.
Could we have a solution based on science and not political voice
Sand sources are a matter of urgency. The Dept has been too slow
Creating permanent infrastructure is the only way to protect our beaches from future de-funding. The pipeline option must be implemented to save our beaches for our children and beyond
It would be so much better if you considered the natural environment first and foremost, learned from best practice around the world rather than stubbornly following a predetermined course of action, and stopped trying to shore things up for the benefit of those benefitting commercially and politically from the West Beach area.
permanent infrastructure needs to be developed to protect the beach management from future de-funding

No one is arguing littoral drift doesn't go from sth to north.
No one without looking at the science can in good faith argue that the existing pipeline from Glenelg to Kingston is a failure or more importantly doesn't provide a benefit to the whole section of coast in which it operates inc Glenelg the source of sand for the pipeline.
The pipe offers the whole coast a genuine solution to replenishment and restoration of west beach whilst providing flexibility for collection and distribution along the whole coast.
We the state of SA can not be held to ransom by biased views from communities who fail to recognise the cost and value of the 'whole of coast' and not just a pocket of it.
I have grown up on this beach since the late sixties and as a life member of West beach Slsc have seen our beach sacrificed for the benefit of all other beaches. My reference for what this beach can be goes back further than most and although I know we won't get back what I remember was here, I want to ensure all future generations of Adelaide and visitors in the future have the same enjoyment I still currently experience.
The ABMR process has delivered options: the dredging options, that in my opinion will meet the 3 government goals. I am very grateful for that and appreciate the opportunity to have my say. Few places in Australia, excavate their beaches, with dredging being the most common method of sand transfer. There's also a shift from onshore to offshore processes. Coogee in WA has shifted processes in the main to keep its beaches open. I hope too that we use an offshore process or processes.
I also support the complementary shortlisted options which are-seagrass rehabilitation, smart monitoring, dune rehabilitation and beneficial reuse such as the reuse of excavated sand from beachfront development sites for beach replenishment and dune restoration, as occurs in the Gold Coast . This latter point is of particular interest. There are regulations for builders and developers which require the return of excavated sand from seafront building sites to the council. Sand is deposited in the dunes or in the near shore. This sand is stored for future storm response or placed in the intertidal zone to allow natural distribution along the coastline, for dune restoration and beach replenishment.With continued development and redevelopment along Adelaide's metropolitan beaches, this may be a sustainable source of sand to consider for dune restoration and beach replenishment. For example, the Fort Largs development on the Taperoo Esplanade, subdivisions along many of our coastal suburbs, and also in the nearby regions.
Around the Largs Bay area the beach has already been damaged extensively & families cannot use the beach
What are the real timelines & implementations for solutions. Previous liberal govt signed up for pipeline solution, the Labor govt then decided to not go ahead, all that has happened in the last 18 months is more of the previous same investigations & reviews, very disappointing with no solutions in sight, leadership & action is required
Please stop the ongoing destruction of the central beaches. Just because we have a Liberal member in Colton, it does not mean the our beaches should suffer. Once it's gone, it's gone! The people, not

the beach, voted Matt Cowdrey into power. This is bigger than Liberal vs Labor. This is bigger than red vs blue. This is your responsibility. Do something about it.
I am sympathetic with finding a solution to this issue, and to the complexity of this. Also there are 'local' views that compete with other areas. However new information has shown that all Adelaide beaches are loosing sand, and it is not as simple as a south to north drift anymore. Obviously, this is multifactorial and climate change may be impacting as well. Thank you for the opportunity to comment.
We already had a solution 2 years ago after lengthy studies and options researched. Has the cost of maintaining the beaches for the last 2 years, cost of the review , cost of cancellation of the pipeline contract been added to the the other options ?
With a mass fill and a pipeline the actual beach and sand volumes will remain the same and consistent both south whilst slight increasing to the north.
It is time for a non political decision to be made for the benefit of all.
The pipeline is a longer term solution, that may still require mass fill periods , but reduces the extent of trucks along multiple beaches.
I work at Glenelg, near the beach works-it's time it stopped. i dont think we should do the same at Semaphore. Dredge seems best options
Please listen to the community. Not JUST in this survey but for years. Please stop seeing this solution as a segmented one, divided by suburbs. Solve this problem with a systems thinking approach. Nature is a whole, collective system, not one divided by roads or suburbs. Respect this coast. Think in generations, plan in decades/years and act through listening. Be open to more options than just those listed here. While taking inspiration from overseas, please remember this is a unique coast. It is not a European coastline for example, it is one that has been here for millennia and is unique to the native flora and fauna which characterise it. Thank you for your community consultation, just please ensure our voice and ideas are heard and considered.
Other options to source sand should be explored, I.e. Murray mouth is dredged regularly anyway.
Explore options to stop sand movement, such as sea grass restoration and oyster reefs.
Climate change and sea level rise is happening, some buildings too close to the coast may have to go.
I consider it disgraceful that the current government cancelled the pipeline contract at great expense and has instigated this unnecessary so-called independent "scientific" review. I believe this review is a political scam to delay doing anything during the term of the current government. I consider it bordering on unethical behaviouir that the consultants for this review have included the three dredging options and ignored previous extensive investigations that there are no feasible off-shore sources of sand.
The construction of the pipeline is going to damage the dunes. No pipeline please.
I think the options with most flexibility and least disruption to communities along the coast.

Machinery on 2 beaches is not desirable. The beach at largs bay still shows signs of quarrying from previous work. Sand dunes still collapsing and receding
More research needs to be done for better cheaper resuts. If you want to save West Beach . Why do 7 beaches have to be sacrificed to save 1, when all beaches should be protected. There are other ways to fix the errosion at West Beach. Why are you still using a 50year old method , that is clearly not working. What is generating is the MASSIVE MOVING SAND DUNE. That is taking people's property. Find this and you will find your solution. Mixed with a courser sand, of course,, to slow the effect of erosion at West Beach.
I am happy to show you the extend of the Massive Moving Sand Dune. 0418 197 688 for more information .
I strongly support effective measures to manage sand and to create and maintain dunes at West Beach.

Appendix D – Summary of submissions table

Number	Date received	Sent from	Representing	Summary
1	18/09/2023	Bill Hollingsworth		Bill thinks that the main causes of the sand erosion are the groins, development on top of sand dunes and sewer water destroying seagrass. They think that work to build up the beaches will go on forever as Adelaide has a soft coast line and is naturally eroding.
2	20/09/2023	Mark Pierson		Mark gives lot of in-depth detail about sand sources, coastal movement and climate change. Mark thinks that a sand engine is the best option with mass nourishment and gives some information on the system. Mark supports 1.1, 1.2 and 1.3 due to dredging slowing the rate of erosion, Is cheaper than a pipeline but sand sources should be considered further. Mark also thinks that the position of the sand is important so it doesn't just wash away. Mark does not support any pipeline options or option 3 due to environmental damage, social amenities, costs, decreased amenity, microplastics trucks on beaches, and having a stranded asset
3	21/09/2023	Phill Crossing		For sand replenishment Phills first choice is quarry sand and if this is off the table then they like dredging 2km offshore
4	29/09/2023	Anthony Brattoli		"Why is sand not taken from Largs North - North Haven far too much build up "
5	3/10/2023	Paul Nankivell		Paul thinks that groynes and breakwater should be a solution. They think that wave energy converters would also be a great solution to save the beaches and money.
6	4/10/2023	John Dundon	Save West Beach Sand.	John thinks that time is of the essence. John thinks that there needs to be an Environmental Impact Study assessment (EIS) for future coastal projects. They also think that the solution needs to be one that suits the whole coast and the solution needs to be conveyed tot he community. John does not support any dredging options. This is because of potential seabed damage, damaging plumes, lack of viable sand sources, unreliable sand supply, cost and Pacific Oyster Mortality Syndrome. John doesn't think that dredging options align with the reviews term of reference. John thinks that pipeline option 2.1 is the only environmentally ready solution and shared the burden of disruption around to all beaches. John thinks that sand mass modelling needs to be done and that time lines need to be shorter to ensure minimised negative effects. John does not support trucking as anything but a last report. John provided lots of data on sand cell volume and drift.
7	4/09/2023	Alan Young		Alan gives a short background of the current sand issues. Alan doesn't think that many of the short list options have been properly researched due to time and cost constraints and doesn't think that the EPA would approve sand dredging even if there was adequate supply. Alan also thinks that sand carting is unsustainable environmentally unsound. Alan thinks that the back passing pipeline option 2.1 is the best option. Alan shared and article from the advertiser for 19/9/23. Alan thinks that efforts need to be made soon to prevent more damage.
8	6/10/2023	Grant Warner		Grant is in favour of near shore dredging pumped south though they think that it is not environmentally friendly. Grant thinks that trucking is a prompt and cheap compromise. Grants suggests dredging around North Haven entrance with a capturing pan. Dredging to a depth of 2m is required. Grant also thinks that rocks should be placed to prevent sand erosion.
9	8/10/2023	Kay Ronai		Kay give an outline of her involvement in the project. Kay thinks that the dredging options are suitable. This is due to less community disruption, keeping sand on beaches and sand distribution. Kay has 2 conditions on which to accept the dredging; an environmental evaluation and real time monitoring to stop work if conditions deteriorate. Kay thinks that more explanation around option 1.3 is needed. Kay thinks a multipronged approach with the inclusion of seagrass beds and reefs should be used. Kay strongly opposes all pipeline options and wants an Environmental Impact Statement to be made on these. Kay objects because they think that the pipeline is too expensive, out of date, intrusive, and doesn't to allow for the effects of climate change. Kay thinks that West Beach deserves better sand than Semaphore and Largs bay and that a pipeline is not environmentally friendly. Kay is opposed to carting sand from Semaphore and Largs and would only support carting from a quarry if appropriate grain size is used as an interim option. Kay thinks that carting is too expensive.
10	9/10/2023	Kate and Graeme Denton		They think that this decision is being made based on money and votes not reducing environmental damage and carbon emissions as it should. They think that the indicative costs of these solutions do not take into account climate change and its effects over time on the solutions. They think that the government should be honest and admit that some beaches and some infrastructure has to go. They cannot not pick an option as not viable 20 year projections have been given. They think that the West Beach boat ramp needs to be demolished and more focus be put on science and less on PR.
11	10/10/2023	Dianne and Mark Burns		Dianne and Mark think that the dredging barge variant option is the best. They think that this option is Most Flexible, Least Disruptive to Beach Amenity and Communities, Most Effective for Keeping Sand on Beaches, Most Economic Strategy.
12	10/10/2023	Alan O'Connor		Alan thinks that 1.1 'Dredging existing sand near the shore' is the best option. They think that it appears to be the cheapest option and the one preferred by most locals as it ensures that there are no trucks or pipelines on the beach and minimizes environmental damage.
13	11/10/2023	Warwick Norman		Warwick strongly supports Options 1.1, 1.2 and 1.3 provided an Environmental Impact Assessment is undertaken prior to work beginning, work is done far from the beach, only quarry sand is considered for 1.3 and alternatives to trucks are sought, and that Bird Island is not used as a sand source. Warwick is strongly opposed to Options 2.1, 2.2, 2.3 and 3 because environmental damage, lack of source flexibility, cost, micro-plastic contamination, beach access and integrity. Warwick thinks that quarry sand could be used as an interim solution.
14	12/10/2023	Kelly Mader	The City of Charles Sturt	CoCS give some background as to why the beaches are so important to them and an over view of current management practices. CoCS think that mass nourishment needs to occur before anything else as a short term equilibrium measure. Options 2.1 and 2.3 are supported and also 3 as a last report. CoCS are neutral towards 1.2 and 1.3 as they could work but not enough research has been done. CoCS are opposed to 1.1 and 2.2
15	13/10/2023	Kristin Vonney		Kristin thinks that sand carting and pipeline options are not in line with maximising sand on beaches, cause environmental and community disturbance and release micro plastics. They also think that littoral drift of sand from south to north has not resulted in a build up of sand on Henley North, Semaphore and Largs Bay beaches. They think that dredging is best due to sand grain size, distribution to communities and environmental impact.
16	13/10/2023	Carol Crossley	Sandpiper Dune Care Group	Carol strongly supports 1.1, 1.2 and 1.3 because of least disruption most flexible, sustainable, and scientific. They think that these options maximise sand on beaches. Thinks that effort need to be made in these options however to minimise impact on seagrass. Carol strongly does not support options 2.1, 2.2, 2.3 and 3. this is due to cost, degradation of beaches, grain size, amenity, maintenance, micro plastic, wildlife and community disruption and danger.
17	13/10/2023	Karyn Holloway		Karyn is strongly opposed to options 2.1, 2.2 and 2.3 due to the detrimental effects on the dunes and noise. Options 1.1 and 1.2 are good but Karyn thinks that an environmental Impact statement is needed and thinks that option 1.3 is questionable as the distance form the shore is not specified. option 3 is only acceptable if only quarry sand is used.
18	13/10/2023	Maggie Hine	The City of Port Adelaide Enfield (CPAE)	Council describe their existing positions on the project. Council conditionally support options 1.1, 1.2, and 1.3 sighting further investigation is needed on sand source, environmental impacts and noise impacts, as well as economic analysis and the exclusion of Bird Island as a sand source. Council do not support any other option

19	14/10/2023	Sandra Dann	Semaphore Largs Dunes Group (SLDG)	Sandra gives an over view of the group and its work. The group support options 1.1, 1.2, and 1.3 subject to environmental assessment and approvals. They think this because dredging will let dunes recover, reduces bird habitat impacts, and will give the group confidence to continue. SLDG question how well the proposed short-listed options adhere to the terms of the review. They think the impacts of previous campaigns needs to be looked as well as the effects of climate change and micro plastics. They don't think that the pipeline extension to Largs was properly consulted on. They also think that this review has been limited in scope and fear that if further investigation rules out dredging options, all they are left with is a pipeline and they do not support this. Options 2.1, 2.2, and 2.3 are not supported by SLDG and 3 is only supported as a last resort in times of crisis.
20	14/10/2023	Bernadette Cranwell	Henley Dunes Care Group	The group give a detailed recount of their groups involvement in the sand erosion issue as well as the DHI report. The group think that Henley Beach South and Henley Beach are not mentioned in this report and should be. Due to this sites not being included, these beaches are not receiving the nourishment they need. Henley has not road access and so is reliant on other beaches for sand movement. They believe that the Torrens outlet should be left untouched by any proposed solution. The group think that Options 1.1, 1.2, 1.3 will cause environmental harm and are unlikely to be accepted by the EPA. The group think that Port Stanvac is unsuitable as a sand source due to quality and quantity and the section Bank is also unsuitable due to Oyster Mortality Syndrome (POMS). They also think it is hard to comment on options where the sand destination is unknown. They think that sand carting should only be used a last report due to disruption and environmental harm. Option 2.1 does not mention Henley beach for replenishment and should by they are happy that a design is ready to go and approved. They think a pipeline will provide certainty flexibility and will not be seen. They ask that the panel ensure that the solution picked is sustainable, treats all beaches equally, flexible, and longevity.
21	14/10/2023	Kerry Rensonnet		Kerry thinks that options 1.1 and 1.2 meet the goals of the review, providing there are environmental turbidity and sea grass studies done, but 1.3 needs more information. Kerry thinks that the pipeline and carting options will be very disruptive to community and business and think that it is also expensive. Kerry also think that dredging causes less environmental harm. Kerry thinks that sand placement in dredging options needs to be considered. Kerry does not support pipeline options as they cause disruption to community damage the environment, increasing erosion and cause dangerous conditions on the roads and beaches and cause large holes. Kerry thinks that climate change needs to be a part of this review, that updated information needs to be used by Blue Coast and that no sand should be removed from any beach.
22	14/10/2023	Deb Walker		Deb provides some history of her involvement and her knowledge base. Deb thinks that only one community are benefited by all options and that no communities benefit from options 2.1, 2.2, 2.3 or 3. Deb think that these options do not align with the goals of the review. Deb thinks that the sand at Semaphore and Largs is not appropriate form replenishment and that this should have been considered by Bluecoast. Deb raised this issue at the workshop and was dissatisfied with the answer she received. Deb has concerns about how option 1.3 does not state how far from the beach dredging will occur and she didn't feel confident based on the answer she received that the barge wont be close to shore. Deb thinks each option will have environmental impacts but that dredging will have the least impact but does ask what the fall back is if this is to the case. Deb thinks that tides and climate change events need to be considered. Deb thinks that dredging the Murray Mouth should be reexplored.
23	14/10/2023	Geoff Wood	Adelaide Coastal Community Alliance	The group thinks that Soft Engineering like sea grass management should be included in actions taken. The group Strongly support Options 1.1, 1.2, 1.3 because they are the most flexible, least disruptive and most effective for keeping sand on beaches and most economic. The group support the use of mini sand engines and give some explanation as to why. The group think that sand recycling is tenuous and would continue to divide the community where there is opportunity to unite. The group give some information about possible sand sources. the group strongly does not support Option 2.1, 2.2, 2.3 due to costs, lack of flexibility, community impacts, and microplastics. The group does support minorly option 3 if only quarry sand is used.
24	14/10/2023	Marty Cielens	Western Adelaide Coastal Residents' Association (WACRA)	WACRA is disappointed in the information from Bluecoast and thinks more effort needs to be put into the long list options. If this isn't to happen then Bluecoast need to provide more scientific evidence for the options presented and have community questions answered. if this was to happen, WACRA would support option 1.2. they would support this as it results in the least damage to dunes and environment and removes trucks, flexible, climate change proof, microplastics and maximises sand staying on beaches. WACRA explain in depth why they think the ABMR process has failed. they want to see environmental impact studies done for each option especially the dredging options. this is especially requesting for dredging options as it is understood that the can cause environmental harm. WACRA also think that Bluecoast information contradict DEWs information and they have questions about certain locations and their suitableness for dredging as well as questions for each option individually.
25	14/10/2023	Bill Lucas		Bill thinks that groins need to be considered more and wants to know why there hasn't been reports on their use in this review.
26	15/10/2023	Michael Walker		Mike supports option 2.1
27	15/10/2023	Charles Steer		Charles was disappointed with the report materials and thinks they were lacking. Charles thinks that the makes it hard to make an informed decision on the options. Charles supports sand pumping options.
28	15/10/2023	Jane Edwards		Jane explains what she means when she says 'community engagement and amenity'. Jane wants to see evidence of cost-benefit analysis and evaluation of community impacts of the short listed options. Jane thinks that taking sand from and eroding beach to top up another is not right. Jane thinks that options 1.1 and 1.2 allows flexibility. Jane thinks that option 1.1 reduces community impact and shore environment but may have negative impact on sea environment. Due to this Jane wants an environmental impact assessment. Jane thinks that option 1.2 means trucks will be on beaches and that Pt Stanvac is not a suitable sand source. Option 1.3 is similar in that Section Banks is not suitable for sand and the option in includes trucking. Jane thinks that options 2.1, 2.2 and.2.3 are completely unacceptable because they are unsustainable, costly, inflexible, cause community disruption are ineffective and pollute. Jane also does not support option 3 due to environmental damage and community disruption.
29	15/10/2023	Melanie Carter	Taperoo Dunes Group	The group gives an overview of their work and makes some general comments for panel to consider. The group think that climate change needs to be considered in the solution as well as flexibility, sea grass restoration, sustainability and up to date data needs to be used. The group does not support any of the pipeline options. They think that the proposed sand sources are not suitable and a pipeline will cause environmental damage disrupt community, and release micro plastics. The group also does not support option 3 due to dunes harm, reduce community amenity and contributes to erosion. The group supports all the dredging options because the EPA will monitor the works and that areas can be chosen that do not harm sea grass and it aligns with the goals of the review. Dredging is also more flexible and cost effective. They oppose dredging of Section Bank however.
30	15/10/2023	Amy Beardsley	The Henley Beach Business Association Incorporated, (HBBA)	The group gives an overview of their work and the review. The group think that 1.1, 1.2 and 1.3 are the best options as they cause the least amount of disturbance to community. The group do not support 2.1, 2.2, 2.3 or 3 due to the disruption to community, the environmental impacts and suitability of sand sources. The group strongly oppose the closure of jetties and think the equipment involved in all pipeline options are very disruptive. The group think that system like that in the Gold Coast that has a purpose built jetty would be better. The group think that efforts like sea grass restoration, dune rehabilitation smart monitoring and reuse of sand should be incorporated.

31	15/10/2023	Peter McGregor		Peter gives an explanation of his role and what he has seen over recent years as a councillor. Peter thinks that sand carting and pipelines cause damage to the environment and the community. Peter supports dredging. Peter supply's a news article about his contribution to the cause and some graphs and images showing sand loss.
32	15/10/2023	Steve Medhurst	Henley Coastal Voice	The group give an over view of their involvement so far. They think that flexibility and immediate solutions are important. The group think that option 1.2 is the best with 1.1 the second best. They think this as dredging creates the least amount of impact on communities and the environment as well as it is more flexible, cost effective and maximises sand on beaches. The group give more in-depth explanation for these benefits for options 1.1 and 1.2. The group thinks that the inclusion of trucks in option 1.3 means there will be community disruption and environmental harm and hazards. They think that trucking is an urgent reaction that is needed now and should be considered in the future if urgent top ups of sand are needed. The group think that an environmental impact study needs to be done for all options but especially dredging to show that its impact on sea grass and other environmental factors is low. The group think that dredging provides needed flexibility for a whole coast solution as sand source and volume can be adapted and the cost is the most economical. The group also think that a sand engine is required. The group rated the 3 pipeline options lower than the dredging options as these will create community and environmental disruption whilst running and during construction, will restrict beach amenities and are more expensive and less flexible. The group provide 2 appendices about Complementary Strategies and the current situation.
33	15/10/2023	Ian Dyson		Ian gives an overview of his association with Adelaide beaches and an over view of this stage of review. Ian thinks that option 2.1 is the only viable option as long as there are minimal intake points. Ian thinks that the retention of replenished sand need to be modelled. Ian thinks that the dredging options crate to much environmental impact. Ian gives some more information about sand sourcing and supply.
34	15/10/2023	Carl Charter		Carl's submission is supported by 8 people and groups. The group strongly support option 2.1 and do not support all other options. The group think that there are no suitable sources of sand offshore due to marine life especially seagrass and impacts and the flow on social impacts of this. The group think that carbon footprint assessments would show that a pipeline is the least damaging. The group also think that dredging will cause unacceptable turbidity which will effect bathing water quality. The group give lots of information about a report written by Prof David Cox, sea grass rehabilitation, sedimentation, and water clarity as explanations for not supporting option 1.1 and 2.3. The group think that Port Stanvac is not a suitable source of sand and talk about the dangers of dredging e.g. sediment plumes to show opposition for option 1.2. the group do not support option 1.3 due to the impacts on the source location. The group do not support 2.2 as they do not think that this systems would work in Adelaide even though it works in other locations in the country. Option 3 is not supported due to safety issues, congestion, road damage and emissions.
35	15/10/2023	Robyn Ravalico		Robyn gives and overview of the review and gives detail about climate change effects and community views on the reviews goals - minimising community disturbance and environmental harm and maximising sand on beaches. Robyn also gives information on climate change impacts, costs and time implementation. Robyn gives a score for each option with all pipeline options receiving a 2/15, option 3 receives a 4/15, dredging options 1.1 and 1.3 score 13/15 and 1.3 scored 11/15. Robyn thinks that the dredging options are the ones that need to be progressed.
36	15/10/2023	Tony Bazeley	Port Adelaide Resident's Environment Protection Group	The group gives and overview of coastline movement and sand sources. The group think that dredging Section Bank and Port Stanvac is not inline with the goals of the review and will cause environmental harm. The group talk about alternative sand sources and how sourcing sand form metro beaches is a good solution. The group do not support option 2.1 as it is not sustainable, cost effective and causes restriction to amenity and causes environmental harm. they also do not support 2.2 due to stress on heritage jetties caused and loss of public facility. They also do not support 2.3 due to opposition on dredging due to environmental impacts and costs.
37	15/10/2023	Jennifer Deans		Jennifer request to have her thoughts heard by the panel but not released publicly. They think that several of the options presented are not feasible or are undesirable. They think that appropriate grain size is important, turbidity management needs to be undertaken, proper sand sourcing and moving techniques are needed, confirmation of sand sources need to be confirmed, jet pumps suitability for Adelaide coastlines needs rethinking and climate change needs to be included.
38	16/10/2023	Lee Grandison		Lee thinks the current state of the beaches is upsetting. Lee thinks there are lots of negative effects of the past management techniques such as hard sand, shell reduction, sand dunes are turning into dirt, and sand volume reduction. Lee provides some idea for fixing the erosion issues such as removing breakwaters. Lee also doesn't think that the Adelaide beaches are being effected by climate change.
39	23/10/2023	Gordon Anderson	City of West Torrens	CWT will submit their final submission on Friday 20 October. CWT thinks whatever management approach is taken needs to include, sand nourishment and sea grass and dune restoration to help mitigate climate change. CWT give a summary of the background issues and outline the short listed options. CWT think that measures taken need to be flexible and adaptable. CWT think that all options will have environmental and social impact and be effected by climate change. CWT think that not enough information is given on any of the options but that the current management is concerning people. CWT support option 1.2 as they think it aligns with the goals of the review best. they think that this option avoids intrusive activity, requires no machines or sand carting and think that it is cost effective and flexible. CWT do acknowledge that this option does however come with its own risks to the environment like disruption to aquatic flora and fauna. CWT think that an environmental impact assessment needs to be undertaken before work on any option begins.

Appendix E –Written submissions

From: Bill Hollingsworth
To: mail
Subject: Adelaide beach erosion.
Date: Monday, 18 September 2023 5:25:01 PM

Hi
The problem of the erosion of the Adelaide metro beaches is primarily the covering up of the sand dunes due to building development. They once were the reservoir of sand to replenish the beach.
Secondly the groins along the beaches act as dams against the littoral drift of sand from south to north.

Thirdly the enriched water from the sewer outlets has destroyed the seagrass that captures the sand as it naturally goes out with the tide or storms and the sand flows out to to offshore submarine canyon and can't return to the shore again.

Basically any work to build up the beaches will be ongoing forever and nature will work faster than any of the proposed beach rectification options. Seawalls only accelerate beach erosion, but they will continue to be built. To top it all off geologically the Adelaide coast is a soft coastline that is naturally eroding.
Cheers Bill Hollingsworth

Adelaide Beach Management Review:

Dredging offshore sand for mega-nourishment to manage sea level rise

You cannot solve a problem with the same mind that created it.

Albert Einstein

I can think of forty reasons why none of their projects can possibly succeed and forty tones of wry cynicism in which to express my well-documented doubts. But I also know that it is more humanely beautiful to risk failure seeking the hidden springs than to resign to the futurelessness of the wasteland. For the springs are there to be found.

Theodore Roszak, 1969

Prepared by Mark Pierson for the Adelaide Beach Management Review

Background

Global sea levels are expected to rise by between 0.6m and 1.1m by the end of the century and there will not be enough sand to sustain all of Adelaide's beach users in the lifestyles to which they have become accustomed. Dredging Gulf St Vincent would appear to be the most cost-effective and flexible medium-term option however it is not a solution to the problem of sea level rise because you cannot hold back the tide. There are a range of short-term, medium-term and long-term measures that will be necessary to manage sea level rise along the Adelaide metropolitan coast for the benefit of all South Australians. The use of offshore dredges and/or dredge-barges to mine offshore sand resources is a system that is being adopted elsewhere, is economically justifiable and has multiple additional social and environmental benefits. The comprehensive cost of an offshore dredging program has been economically evaluated and mass replenishment with external sand helps to slow the rate of erosion and protects community assets. Building the beaches and dunes further west, away from infrastructure, attacks the problem of sea level rise by building up sand dunes and seagrass beds, rather than retreat and defend using rip-rap, rock wall revetments, which now appears to be a losing strategy.

Mass nourishment of West Beach involves the placement of a large store of sand in the vicinity of the Torrens Outlet to supply the downdrift Henley Beach cell over the medium-term. This coastal management concept is referred to as mass nourishment or a sand engine. The concept has several advantages in that it improves the economics of utilising larger scale dredge plant, to reduce the costs per cubic metre of the dredging and nourishment, while providing a source of sand to meet the downdrift transport capacity for many years, reducing the impact on beach users from frequent sand carting campaigns. It also reduces the rate of erosion. That being said, using a smaller dredge over an extended period of time might cost a little bit more but will have fewer environmental consequences in the marine environment.

This option would require approximately 500,000m^3 of sand to nourish the West Beach cell and 300,000m^3 of sand to nourish Henley Beach South to restore the littoral volumes back to the late 1990's cell volumes. An additional ~1,000,000m^3 would also be placed on West Beach updrift of the Torrens Outlet at Torrens Outlet dunes. This would provide approximately 10 years of supply (at a transport capacity of ~100,000m^3 per year) to Henley Beach cell. It is envisaged the large store of sand would enhance the natural groyne function of Torrens Outlet and assist to slightly re-orientate the updrift shorelines of West Beach, thereby reducing the longshore transport capacity and subsequent volumes of ongoing nourishment of West Beach. Adding to the volume of the sand engine year-on-year would improve the functioning of the sand engine, without ruining the marine environment and the cost would only be slightly more than hiring a dredge every 10 years and still, most certainly, much less that the cost of the fixed pipeline. You're welcome.

If that scenario were to play out, with at least 1,000,000m^3 to be placed at West Beach every 10 years, there should be sufficient sand in the system for some to be back-passed from the Torrens Outlet to the southern end of West Beach using existing pipeline infrastructure, as an interim measure. Ideally, though, some of that sand might also be pumped to Glenelg North, whose sand supply could be supplemented by, and intermingled with, dredge spoil from Holdfast Quays Marina and Glenelg Beach thereby minimising disturbance from trucks operating along that stretch of beach.

Sand that would be allowed to accumulate around the western edge of the West Beach boat launching facility, could then be pumped back on to the beach at West Beach, using a small cutter suction dredge and intermingled with seagrass wrack that is presently dredged from inside the boat harbour, further stabilising sand volumes on West Beach, with minimal disturbance, hopefully building the dunes back up with sufficient volumes to withstand future storms. The actual volumes of sand in the sand engine and in the bar formed around the Boat Harbour, at West Beach and at Glenelg North, would need to be monitored year-on-year and may be adjusted over time, which would indicate the ultimate volume of sand required to replenish the sand engine with a larger, offshore sand, dredge campaign every 10 years.

This option is flexible rather than fixed; provides more sand over time, not less; is less disruptive to each and every coastal community; requires less government expenditure in the short, medium and longer term; causes less environment harm overall, especially if a smaller, more modern suction-hopper dredge is used over a longer period; and is capable of coping with sea level rise in the medium term. It is expected that the use of hard structures (e.g. rock groynes and offshore breakwaters) will be required if we want to maintain our beaches in the longer term (~50 years), even if an infinite supply of offshore sand could be sourced indefinitely.

Danish Hydraulic Institute concluded that mass nourishment at 10-year intervals would add needed sediment volume to the littoral system effectively mitigating the underlying erosion problem. Further, they suggested that interventions every 10 years would minimise disruption to the beach environment (DHI, 2018). They did say that it could be difficult and/or expensive to find adequate sediment source however it would not be any more difficult of expensive than the proposed pipeline option. Everything is manageable with the right mindset and it would seem that the bureaucracy is finally starting to get it and it might just save the State millions of dollars in taxpayers funds.

Option 1.1 – Dredge Existing Sand Near the Shore (QUALIFIED SUPPORT)

The option of dredging around Semaphore and Largs Bay is not supported because back-passing, in general, increases the rate of erosion and that sand will be needed in the future to protect Semaphore and Semaphore Park. Back-passing increases the rate of erosion and, as a consequence, increases the rate of expenditure. Back-passing increases the rate of erosion, principally by increasing the angle of incidence (i.e. the angle at which the waves approach the shore). In general, the more oblique the wave approach angle is, the more littoral drift might be expected to move the sand along shore from where it was placed. Taking sand from where it naturally ends up and pushing it back against an environmental gradient is pushing the system further out of equilibrium.

The Semaphore Park offshore breakwater was designed to slow the rate of erosion around Point Malcom and maintain a dune buffer at Semaphore Park. It worked! The design documents (Carley & Mariani, 2007) show that between 22,000m^3 and 40,000m^3 might be sustainably extracted from the salient, which is situated in the lee of the structure. That sand was supposed to be harvested and returned to the beach system at Semaphore Park, to further slow the rate of erosion there. When the salient is not full, the dunes at Semaphore Park erode to back-fill the salient and there is limited throughflow to Semaphore South, meaning that the dunes there erode as well. Dune sand is finer than beach sand, so the salient would be filling up faster, with finer and finer sand over time, which also increases the rate of erosion.

Depending on the rate of erosion (and deposition), a small suction-cutter dredge could be used to pick up around 22,000m^3 to 40,000m^3 of sand annually that would be building up around the Semaphore Park breakwater if sand carting from the salient ceased and return it to the beach-dune system at Semaphore Park. Similarly, a small suction-cutter dredge could be used to pick up between 50,000m^3 and 75,000m^3 of sand annually that would be rounding the West Beach boat launching facility if sand carting ceased at Glenelg North. It is conservatively estimated that between 100,000m^3 and 200,000m^3 of sand has rounded the West Beach boat launching facility since its construction (note: some of that sand may have come from the old bar that used to close off the Patawalonga) and is situated in an offshore bar, which is beyond the closure depth and not currently connected to the beach system although it may still be performing an important ecosystem function. If studies could demonstrate that there would be no impact on wave energy approaching West Beach, or ecological receptors within the zone of influence, then dredging closer to shore, whether classified as nearshore or offshore, would be supported, as an interim measure, while waiting for more external sand to arrive.

Option 1.2 – Dredge Using Large Offshore Sand Deposits (QUALIFIED SUPPORT)

A sand engine, like the one that the Dutch have developed (Stive, *et*.*al*., 2013) provides a slug of sand that works through the system slowly. In what could be considered a large-scale, adaptive management experiment, a mini-sand engine has formed because of the hydrodynamic groyne that is operating at the Torrens outlet, from sand that has been deposited at West Beach over the last two or three years. Mass replenishment, so-called "mega-nourishment", does not come easy, or cheap, but Israeli research (Bitan & Zviely, 2020) has shown it to be more effective than drip-feeding beach nourishment on an "as-needs", "emergency", or "knee-jerk" basis. There are several remnant offshore sand deposits that are not, at present, connected to the beach system (not including Section Bank, which has been specifically ruled out), which have been identified and assessed by the government (Belperio, *et*. *al*., 1990) and could be economically mined and transported to maintain Adelaide's metropolitan beaches, with minimal social and environmental costs.

Building a sand engine initially requires a lot more sand than the proposed northern pipeline would be able to supply but the benefits include a long-term reduction in throughflow (i.e. reduced rate of erosion), especially when the sand is deposited in the nearshore zone, rather than on the beach face. Importantly, it would be new sand in the system - not recycled sand, which becomes finer over time. Sand recycling is a tenuous way to balance the sand budget because there is not enough sand to go around. Dredging would entirely eliminate the need for trucks on the beach and is a more economically sustainable option for future sand management. An increase in dredge-barge operations increases our capacity for sand management into the future and delivers sand to where it is needed most – in the nearshore zone.

In 2020, the most common method of sand collection around Australia, was by dredge, rather than beach excavation (SWASH, 2023), for all the obvious reasons, including diminished public amenity and a worsening situation due to sea level rise. The shift in approach is to reduce the economic cost and minimise beach closures. There are other social and environmental benefits associated with offshore, as opposed to onshore sand collection systems. A so-called "social-licence, would need to be established to allow dredging in the marine environment. The use of

previously assessed reserves of suitable offshore sand deposits from South Australian coastal waters minimises environmental damage compared with beach sand harvesting and transport by truck and/or pipeline (e.g. microplastics and nanoplastics). Technologies and techniques are available to minimise environmental harm in the marine environment, even if it costs a little bit more, it is still cheaper than the proposed pipeline option, by far.

Flexible offshore dredging and nearshore mass-replenishment by dredge-barge (i.e. suction-hopper dredge) slows the rate of erosion over time, and slows the rate of expenditure, without the need to install hard structures, or the use of trucks and excavation machinery on beaches. However, a suitable sand source may be found more than 25km away from West Beach. Belperio, *et al*, noted that sand around North Haven and Outer Harbour were of marginal quality and identified several large, suitable sand sources between 30km and 35 km from West Beach (see below), which might add to the cost slightly but it would still be a lot less than the proposed pipeline option.

> A review of Adelaide coast protection strategies (Wynne et al., 1984) concluded that beach replenishment using an offshore sand source is a viable, practical and important option for metropolitan beach management. Ideally, 3 million cubic metres of well-sorted, medium-grained sand in less than 20 metres of water is required for a major beach sand replenishment program. An ideal offshore sand source is yet to be discovered and previous offshore investigations are summarised by Wynne et al. (1984) and Tucker and Thomas (1985). Deposits previously outlined at North Haven and Outer Harbour are of marginal quality and/or quantity for a major restoration program.

Source: Belperio, A. P., Harvey, N. & Rice, R. (1990)

The key feature of the proposed sand engine at the Torrens Outlet is that it improves the angle of incidence at West Beach, thereby slowing the rate of erosion through littoral drift. There are no hard structures, so the tip of the artificial spit, thus created, would continue to erode at a rate of between 72,000m^3 and 108,000m^3, depending on grain size, among other things. The proposed sand engine would reduce the rate of erosion at Henley Beach and Henley South, by building the beach further west, making the waves break further out however more may need to be done to modify sea walls and stormwater outlets to reduce the rate of erosion further still.

There would also be sufficient sand in the sand engine to backfill the scour channel at West Beach thereby reducing the nearshore slope and slowing the rate of cross-shore sand movement, keeping more sand on the beach at West Beach, while also reducing the amount of wave energy hitting the beach and the revetment, thereby reducing the amount of reflected wave energy that can entrain sand and transport it further north via littoral drift and longshore current movement.

Moreover, stabilising sand movement allows seagrass to regenerate naturally. The proposed sand engine is thus conservatively expected to reduce the annual average rate of erosion at West Beach, compared to the proposed pipeline, from a possible 144,000m^3, depending on grain size, to around 72,000m^3, further increasing the comparable cost-effectiveness of the sand engine solution in the future.

The most cost-effective size of ships for barging sand around South Australian beaches, would be a vessel with a shallow draft (~3.5m) that is capable of carrying up to 5,000T of wet (dewatered) sand, which equates to around 2,000m^3. While I agree that a large amount of sand (~500,000m^3) would be required initially (~2 years), a smaller suction-hopper dredge that takes 2,000m^3 offshore sediments at a time and/or use of a cutter suction dredge that would take nearshore (and near nearshore) sediments, would minimise any adverse environmental effects associated with the sediment plume from dewatering and turbation. If you did that for 100 days per year, year-on-year, you would slowly build up the sand engine, without killing the seagrass. Avoid the instant gratification of contracting-in a dredge from the international fleet, for the shortest possible period and think more holistically about building up the sand engine slowly but surely. It's not like it would add 1/3 to the cost because the costs associated with mobilisation are sunk costs. Even if it cost 1/3 more, its is still on a par with the next cheapest option, which is not as good for a bunch of reasons, aside from cost (see below).

Option 1.3 – Combination of Dredging Offshore Deposits and Trucking Quarry Sand (QUALIFIED SUPPORT)

Flexible offshore dredging and nearshore mass-replenishment by dredge-barge delivers sand to the nearshore zone, where natural forces will bring it back on to the beach and keep it on the beach for longer. Apart from the massive disturbance to road users and beach goers, placing sand on the beach face at West Beach is a waste of time because it just washes away. It is a waste of money because quarry sand is not cheap. Also, it is a waste of quarry sand, which will be needed by future generations, who will view our use of a building material for beach sand as profligate. The sooner we can implement the offshore dredging program, the sooner we can dispense with sand carting.

Danish Hydraulic Institute concluded that "…ongoing, annual external nourishment campaigns of the order of 100,000m^3 to West Beach would either require unacceptably large numbers of truck movements, which may be disruptive to residents and road users, and/or would be uneconomic (with plant in particular). All management options would need to provide for the ongoing supply of sediment to the downdrift Henley Beach cell, to ensure the erosion impacts observed at West Beach were not simply moved downdrift over the longer term" (DHI, 2018).

Belperio, et al (1989) identified a couple of smaller deposits of suitably sized sand at Port Stanvac, some of which may still be available at a price (and the price would be a Great Southern Reef Marine Protected Area and snorkel/dive amenity like beach entry points) and larger offshore deposits further south that look promising but require further investigation (note: the Maslin Beach deposit would have the greatest social licence because it is analogous to the onshore quarries and the geological strata are known as North Maslin Sand and South Maslin Sand). It is expected that an Environmental Impact Assessment process will be undertaken and that EPA approvals will be forthcoming on the basis of minimal environmental harm, when compared with the alternatives, as well as the use of harm minimisation techniques and technologies. For example, offshore deposits could be selectively mined, using a technique known as potholing (i.e. 3,000m^3 at a time), using a suction-hopper dredge with a green shute, for discharge of smaller amount of sediment-laden water directly to the seabed, where it settles more rapidly, without exacerbating environmental harm through turbidity.

Dredging smaller volumes of nearshore/offshore deposits at North Haven marina, Holdfast Quays marina, West Beach boat launching facility and Semaphore Park breakwater, would be much cheaper than trucking quarry sand and would ensure that the sand was delivered to where it is needed most, in the nearshore zone, where it can come back on to the beach. These offshore deposits are a limited resource and only to be used on an interim basis, subject to stringent monitoring conditions. Re-using dredge spoil in this way would assist in clearing navigational hazards and maintain beach sand volumes.

Option 2.1 – Pipeline using trucks/tractors on beaches (NOT SUPPORTED)

The proposed northern back-passing pipeline represents environmental damage, social anxiety, escalating economic costs, decreased amenity, microplastics in the environment, as well as the possibility of a stranded asset. Apart from being exorbitantly expensive, the proposed pipeline strategy would have perpetuated the use of trucks on the beach. In addition, there is diminished amenity associated with the visual impact and noise pollution caused by the operation of the pipeline itself. There are also immediate environmental impacts associated with the construction of the pipeline, as well as chronic impacts, like increased microplastics in the environment.

Option 2.2 – Pipeline using dredge pump system on jetties (NOT SUPPORTED)

No to nearshore back-passing. That sand is required in situ. No to closing public jetties to support private sector industrial sand mining operations. No to expensive technologies that have a limited shelf-life.

Option 2.3 – Pipeline using a temporary dredge (NOT SUPPORTED)

The proposed northern back-passing pipeline increases the rate of erosion over time and that situation is only going to worsen with sea level rise and would still require the use of trucks on the beach – no!

Option 3 – Sand carting (NOT SUPPORTED)

Taking sand from one metropolitan beach to prop up another just transfers costs and perpetuates community conflict and purchasing sand from quarries is expensive. Communities that utilise and appreciate Adelaide's metropolitan beaches, of which there are very many, all want increased amenity without the heavy machinery.

Conclusion

Dredging large amounts of offshore sand, over an extended period, would spell an end to the so-called "sand wars" and pursuit of the perverse policy predilection of robbing Peter to pay Paul. It would mean wider, more stable beaches and sand dunes and more stable seagrass beds. It has not been easy getting to this point. Hopefully the process that we have followed up until now has served to increase the level of expertise within the Department for Environment and Water and maybe increased capacity elsewhere within government. We can't afford to keep buying-in interstate or overseas expertise, or relying on the community to bring sensibility to a nonsensical debate.

We know that managing a diverse range of human uses in coastal areas requires striking a balance between economic, social and environmental needs. Integration between levels of government, the private sector and the community is a concerted effort to address and develop solutions to the inherent complexity of the coastal zone. Integrated coastal planning utilises stakeholder participation to achieve this holistic, collaborative approach. This form of planning rejects top-down hierarchical planning, which largely ignores the different perceptions and concerns of those involved. Instead, the heterogeneity of coastal systems indicates no "one-size-fits-all" situation exists and that problems are unique, therefore governance cannot be standardised and local knowledge is essential to their solution. Understanding and managing public interest in democratic governance is a complex social process that requires both the integration of multiple sectors and of diverse perspectives (Charbonneau, 2012).

The State Government, which is interested in having more sand and less erosion at West Beach and Henley South, should be interested in investing sufficient economic resources to reflect the true value of all of the Adelaide metropolitan beaches, which is leveraged against the cost of the existing sand carting program over many years.

The proposed northern back-passing pipeline option reflects outdated thinking and outmoded technologies. It cannot be used as a one-stop-shop approach because more sand will be needed at West Beach than can be supplied by the proposed northern pipeline. Working against nature only increases the rate of erosion and increases the rate of expenditure from the public purse and the rate of expenditure will only increase over time. Other jurisdictions are moving away from permanent pipelines and adopting more flexible offshore dredging and nearshore replenishment to improve the economics and amenity impact of beach replenishment programs. Mass replenishment is more efficient than drip-feeding, end-of-pipe solutions. Nearshore deposition is more effective than onshore deposition because sand will wash up on the beach and will stay there longer. Offshore collection for mass sand replenishment is the medium-term answer for improving beach amenity along all of Adelaide's metropolitan beaches.

References

Belperio, A. P., Harvey, N. & Rice, R. (1990) *Offshore Sand Prospects for Metropolitan Beach Replenishment Interpreted from Shallow Seismic Profiles*. Department of Mines and Energy, South Australia, Report Book No 90/13.

Bitan, M. & Zviely, D. (2020) Sand Beach Nourishment: Experience from the Mediterranean Coast of Israel. *Journal of Marine Science and Engineering*, 8(4), 273. https://doi.org/10.3390/jmse8040273 accessed 21/05/2023.

Charbonneau, A. (2012) Integrated coastal planning: 'Wicked' problems and 'clumsy' solutions. *The Arbutus Review*, 3(1).

Culver, R. (1970) *Final summary report on beach erosion studies*. University of Adelaide, Department of Civil Engineering. Report commissioned by the Seaside Councils Committee and the State Government of South Australia.

DHI (2018) *West Beach Coastal Processes Modelling Assessment of Coastal Management Options.* Final Report to DEWNR, prepared by the Danish Hydraulic Institute.

SWASH (2023) Sand bypass and transfer systems around Australia. https://www.swashpd.com.au/resources/sand-bypass-and-transfer-systems-around-australia/ accessed 21/05/2023.

Stive, M.J.F., de Schipper, M.A., Luijendijk, A.P., Aarninkhof, S.G.J., van Gelder-Maas, C., van Thiel de Vries, J.S.M., de Vries, S., Henriquez, M., Marx, S., & Ranasinghe, R. (2013) A New Alternative to Saving Our Beaches from Sea Level Rise: The Sand Engine Source. *Journal of Coastal Research*, 29(5): 1001-1008. https://doi.org/10.2112/JCOASTRES-D-13-00070.1 accessed 21/05/2023.

From: pcrossing <[redacted]>
Sent: Thursday, 21 September 2023 4:20 PM
To: mail <mail@urps.com.au>
Subject: Off sure dredging

If this must happen (replenishment of beachsand)
My preferred option is quarry sand due to its courser particles and therefore erosion resistant properties.
If this option is off the table, the 2nd land less intrusive measure would be to dredge at least 2 kms off shore.
Phill Crossing

Largs foreshore resident for 33 years.
[redacted]

Sent from my Galaxy

From: Anthony Brattoli <[redacted]>
Sent: Thursday, 28 September 2023 7:02 PM
To: mail <mail@urps.com.au>
Subject: Moving sand

Why is sand not taken from Largs North - North Haven far too much build up

Regards
Anthony Brattoli

From: paul nanks

Sent: Tuesday, 3 October 2023 12:45 PM

To: mail Subject: Adelaide Beach Management Review

To Whom It May Concern, Dear Sir/Madam,

I would like to propose another solution to the problem of sand eroding from our beaches. I would suggest groynes, breakwaters that are perpendicular to the coast line to stop the erosion of our beaches. These would require no ongoing costs for one. Two, what if you add to that a wave energy converter system, (apparently it has been successful on King Island)? I think these simple ideas could help us save our beaches and our money.

Anyway, thanks for your time and consideration.

Yours sincerely, Paul Nankivel

Save West Beach Sand
Kaurna Country
c/- John Dundon
[redacted]

4-10-2023.

Dear URPS, Bluecoast Consulting Engineers & Members of the IAP

Our following submission is responding to the URPS request to seek community and stake holders feedback and provide further science on the Options and variants provided as a solution to aiding our metro coastline.

This is further to our 'Your Say' input.

Please note. Dear URPS & Panel. We Request to be heard by the Review Panel to value add and speak to our submission and coastal knowledge.

We understand the science is being led by Bluecoast Consulting Engineers (Bluecoast); community and stakeholder engagement by URPS. An Independent Advisory Panel (Panel) are overseeing the review.

Based on the Options presented,

- the draft-preliminary part extract of the Bluecoast published 'draft Shortlisted Options', and Options published.
- attending and listening to the Bluecoast presentation 27-9-23, and speakers.
- our own study, considered 30-year history of knowledge with commitment, speaking for the metro coast,

-please accept this considered submission.

Preamble.

From the outset our submission seeks to be constructive to assist the Review Panel in reporting good achievable Coastal advice or recommendations to this Government.

Time is critically important to remedy our coast. From your delivered recommendation to successful Option project delivery. Delays will only increase costs, erode the beaches in need further, and isolate sections of the community from one another as positions become further entrenched over time.

It is the role of Government to legislate the needs of an Environmental Impact Study assessment (EIS) for future Coastal Policy and projects, as or if necessary.

This Review should not be used by Government as the means to imply the Review has requested, implied, sought, or recommended EIS provisions. That is outside the terms of the Review and has not been the subject of any public consultation.

The Review should note substantial time savings are possible by not conducting an EIS while correctly acknowledging such Government legislation does not currently exist.

Your reported outcome/recommendation to government must have the best 'whole of coast needs' as the penultimate step leading to a timely and successful implementation by Government.

It is also essential that the Review Report/outcome is transparently conveyed to the community.

Dredging.

Your dredging Options 1.1, 1.2, 1.3 and pipe-dredge variants fail 'strength testing' as viable, achievable, and deliverable options.

Environmental seabed damage, damaging plumes, and lack of definitive, qualitative, viable sand sources in Largs Bay and surrounds with EPA & EIS systemic difficulties prohibits dredging as an option, on a high-risk basis.

Pt Stanvac remains an unsuitable source with sand embedded between clay layers. Damaging clay plumes cannot be discharged into our gulf waters. **The proposed 2021 Pt Stanvac dredging project failed pre implementation in the sand-sourcing investigative phase,** just 2 years ago. Little will have changed.

Unfortunately, Section Bank is not viable to dredge because of the viral Pacific Oyster Mortality Syndrome (POMS) quarantine exclusion zone. If a treatment for this could be found and implemented this sand source would satisfy many of the project's requirements. However, in the absence of such a treatment SA cannot afford to spread the virus. Works to enable and secure necessary Section Bank sand sourcing should have been undertaken years ago, pre this Review by DEW/Government. That sand has been wrongly accumulating for 50+ years.

Our Coastal needs resonate the importance of time being critical, to act expediently. Such dredging options if provided to Government would likely waste many years and not result in dredged sand fruition. We have seen in coastal areas south of Adelaide the damage that can occur when a beach is left to a state of becoming beyond repair. This cannot be allowed to happen again on the metropolitan coast.

Option 1.1 Cannot guarantee every 4th year delivery by future Governments with costs.

Negatively. Delivering sand offshore does "keep the sand moving" most quickly, but why is the long-awaited benefits of sand to West Beach so diminished. Why are the needs of West Beach within this Review, lost or minimised to ensure sand passes in drift faster North than truly necessary? Current rates of drift are fast enough without feeding drift with greater finite and precious sands. Further and consequently, if implemented, West Beach would still endure the greater disruption by plumes by barge activity and accelerated sand loss.

The risks associated with Dredging fail the Review term of reference, "avoiding Environmental harm".

This notion of "keep the sand moving" delivering offshore fails the Review term of reference "Maximising sand staying on the beach" at West Beach.

Regrettably and unfortunately, the current dredging options don't benefit our coast and **are not the panacea we all seek or would wish**. It is a 'tonic' to those unknowing of coastal processes, engineering, and environmental realities. It is not a realistic deliverable alternative or acknowledges the heightened significant associated project risks.

Pipeline.

Option 2.1 Recycled pipeline appears as the only option that is environment ready, with a source of sand, delivery method approved and duplicating the successful southern beaches system. Importantly it offers sand recycling and sharing of sand resources, on a long-term basis.

It ***provides flexibility to both place and collect sand*** **at all pumping stations**. This aids the Review terms of minimising disruptions to all communities by alternating the point of sand source based on best available supply. Effectively sharing the source and destination amongst communities. No one community carries the burden of disruption. We note currently 2023, and in-keeping with much of the past 50 years, 100% of the coastal disruption rests upon West Beach.

Contractual piping agreements provide future assurance and 'Government Commitments'.

Importantly a recycling pipeline ensures sand will be continually recycled each year to continue to nourish the whole of coast to the north in drift, for the project life expectancy.

Positively. We would ask the mass fill to be expedited over an 18-month period. To install the volume mass fill of 550,000m^3 in 18 months, as opposed to over 5 years. Timing remains vitally important to reinstate the equilibrium profile of the beach and allow it to become more sustained. Our community yearns for the environmental benefits and to maximise recreational use, by having the seabed, beach and dunes reinstated/rebuilt. Equilibrium must be achieved asap.

The pipeline delivery method once tweaked enhances the Review term of "Maximising sand staying on the beach" at West Beach.

With all Options we request, - As a must, *the mass fill placement* of volume has to be modelled. Design plans created and published for the mass fill to enable effective community engagement and community consultation. We would request approved design plans showing the anticipated / designed for reinstated profile, beach, and dunes be generated and then delivered. The past practice of dumping sand unscientifically, unmodelled, tipped out of trucks has been wasteful at best.

Positively. One specific aspect untouched or noted in the Review documentation is the **possibility to also extend the Pipeline all the way to the Section Bank**. Post any POMS remedy/solution. Such a further extension would further and greatly ease disruption at all the metropolitan sand source locations on completion. Ensuring further flexibility and minimising disruption into the future, embedded from this option stage.

Ongoing Trucking.

Option 3 is only a last resort. Offers only basic nourishment with disruption at the sand source, on the roads and on the sand destination by trucks and machinery.

This fails the Review terms “minimising disruption to all communities”. Yet, it is offered as an option?

Is this therefore an uncaring Government Political option?

It fails the mass fill reinstatement of West Beach and may only marginally increase the equilibrium health slowly over 20 or so years. Such a long-time period is greatly unfair considering the greatest burden of disruption and loss since the construction of the boat harbour and is continuing to be endured by West Beach.

Additional information aiding your report to Government.

We note that cell sand volume analysis has not been distributed yet.

We provide the following cell sand volume analysis to assist your role in advising Government.

Assessing 2023 current Cell sand volumes.

Summarised.

Cell 6 plus 2,300,000m^3 greater, (more if adopting Closure Depth out to -5m AHD). ACS.

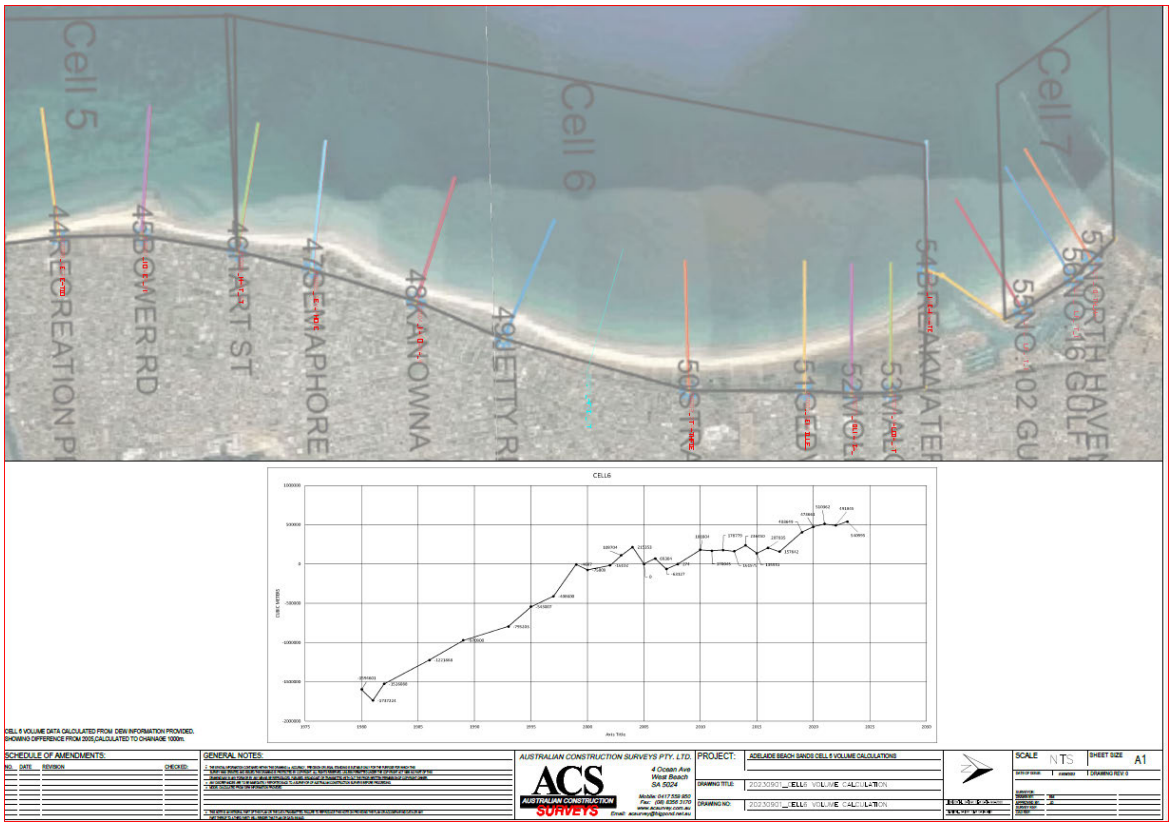
Cell 4 plus 1,200,000m^3 greater, (more if adopting Closure Depth out to -5m AHD). ACS.

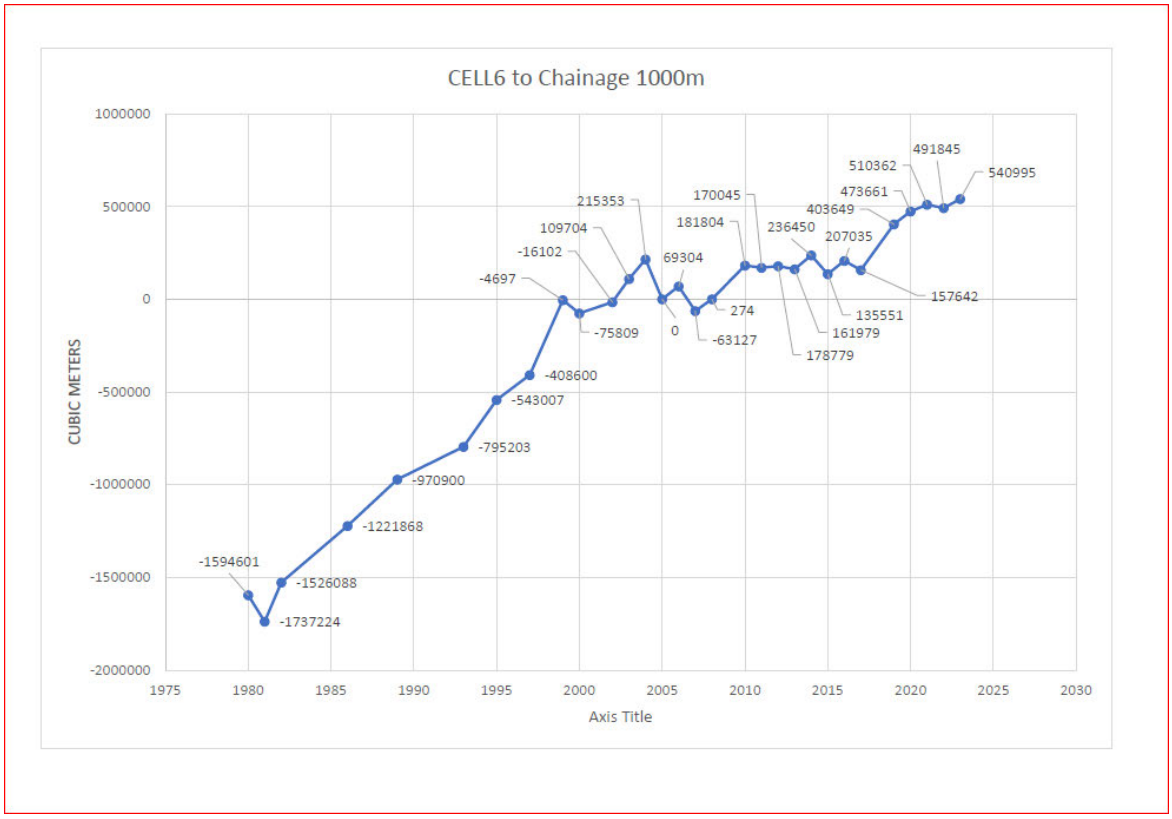
Cell 3 minus 600,000m^3. DHI.

We trust and hope **the Panel highlights to Government current volume analysis** to demonstrate and make argument that the northern beaches can no longer continue to be filled by drift with sand, and of the need to economically recycle existing sand within the coastal system.

Graphed volumes follow.

Cell 6 Volume analysis.

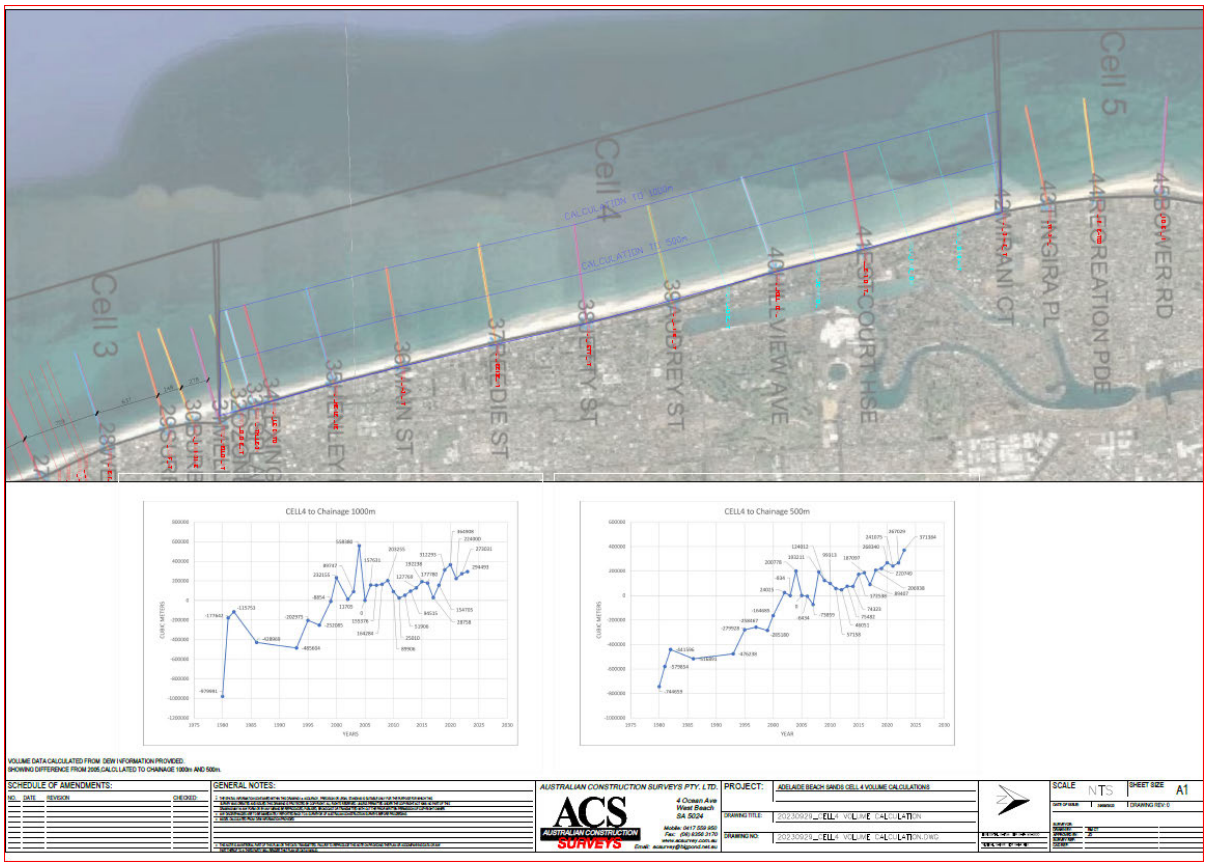


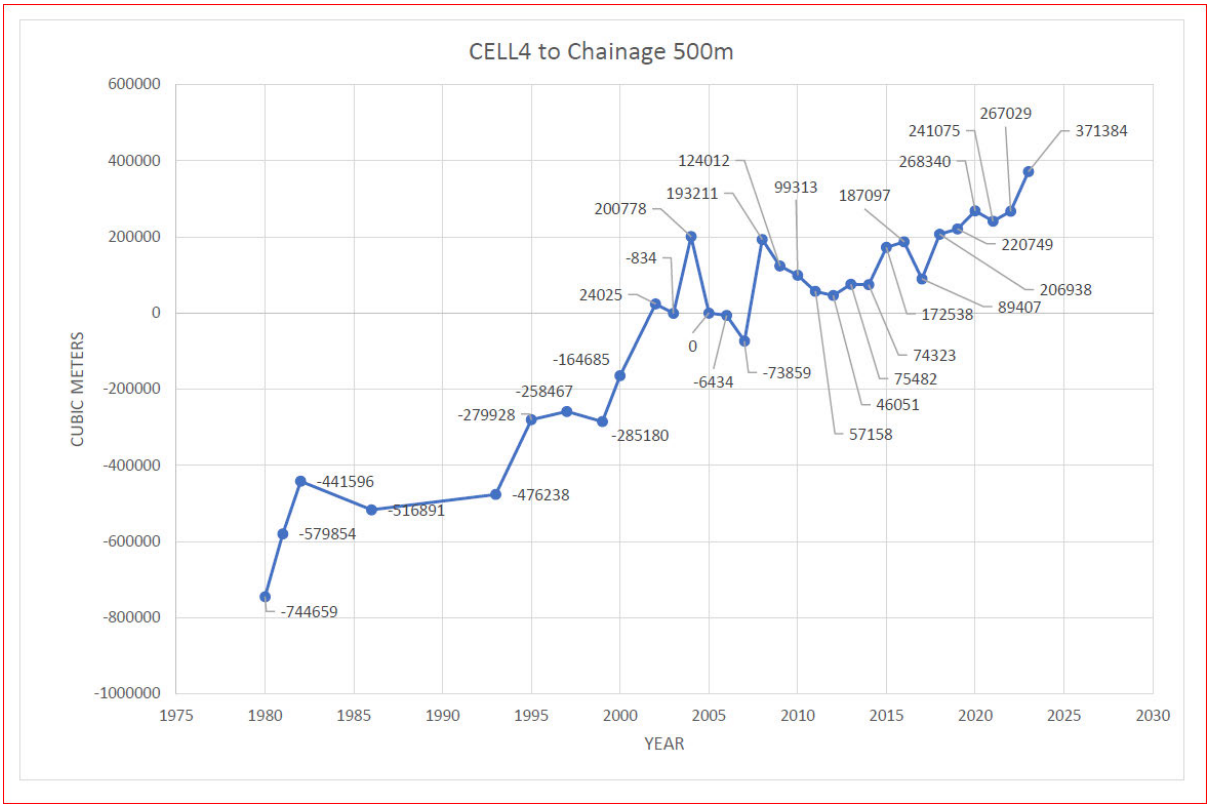


Cell 6, ACS calculation of plus 2.28 million m^3 since 1982. Volume calculated to chainage 1000m along the cross section, and not out as far as -5m AHD.

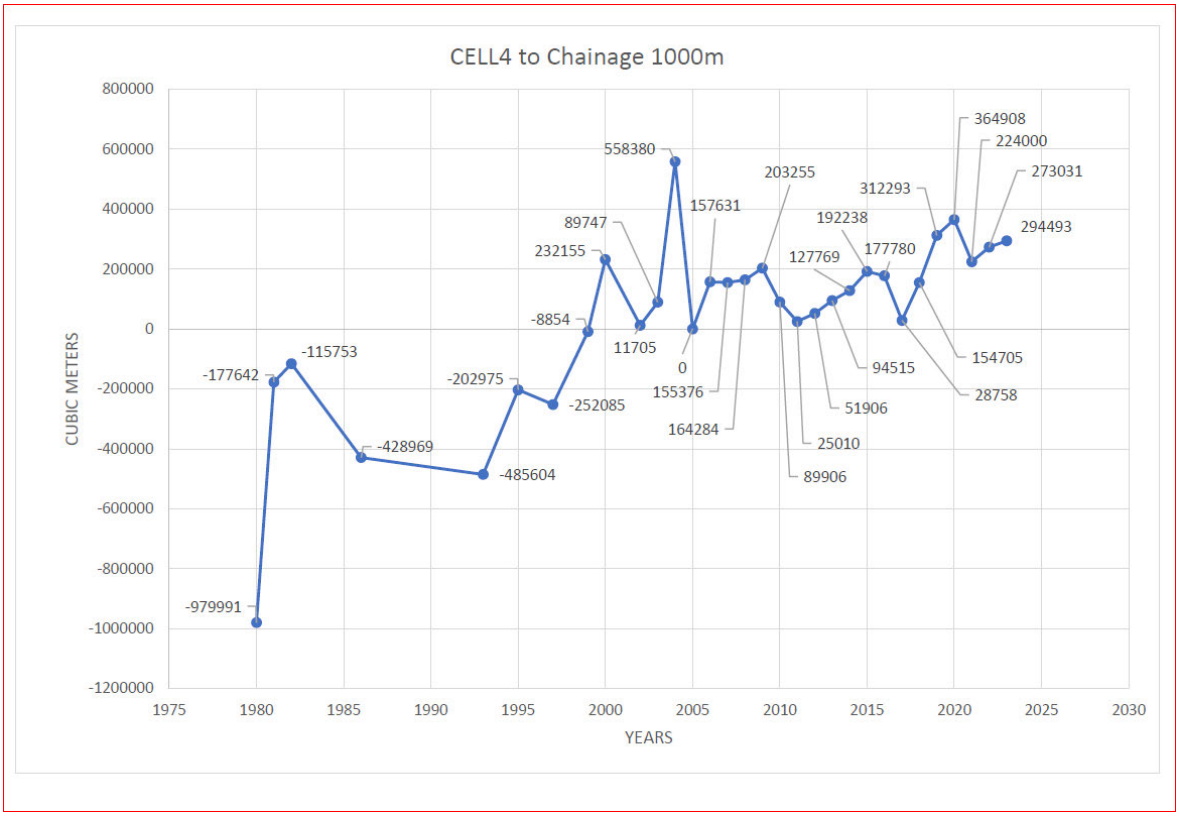
Cell 4 Volume analysis.

We have limited the volume analysis to either chainage 500m or 1000m separately on the cross-sectional data. Both the chainage 500m and 1000m models replicated a similar sum of the volume accrual.





Cell 4, ACS calculation of plus 1.12 million m^3 since 1980. Volume calculated to chainage 500m along the cross section, and not out as far as -5m AHD.



Cell 4, ACS calculation of plus 1.27 million m^3 since 1980. Volume calculated to chainage 1000m along the cross section, and not out as far as -5m AHD.

Cell 3 Volume analysis.

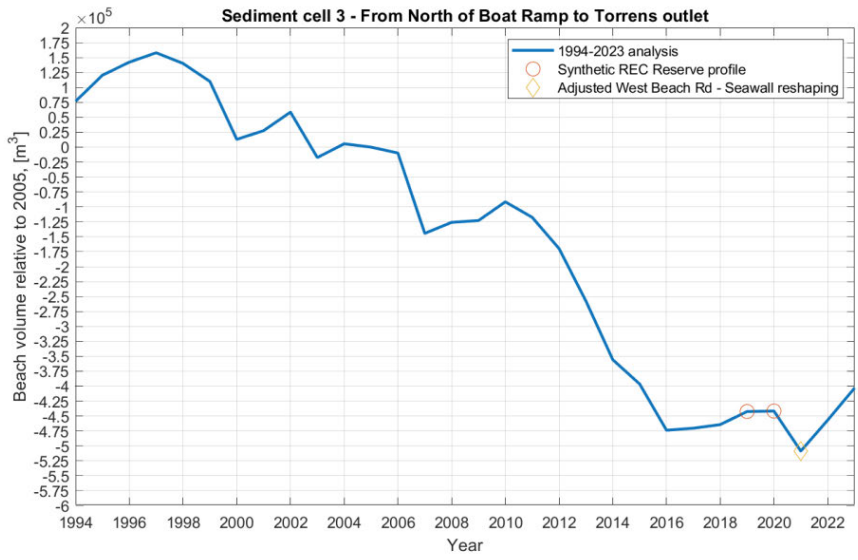


Figure 2-4 Change in West Beach sediment cell volumes relative to the volume in 2005, including 2023 surveys.

DHI have calculated West Beach at minus 400,000m3 from year 2005 levels and minus 600,000m3 from peak.

Summary.

1. Disruption can be minimised but must be equally shared along the entire metro coast. Disruption can no longer remain centred upon West Beach inequitably.

2. The notion of “Keep the sand moving” does not provide sand for meaningful benefit to the West Beach community. Particularly delivered offshore by barge accelerating loss instantaneously by drift. It fails community needs and project delivery costs.

3. Dredging Options 1.1, 1.2, 1.3 have no defined source of sand with consequential risk of delays, environmentally damaging, with genuine potential of non-delivery with EPA & EIS endorsement unlikely. Disruptive plumes associated with delivery will negatively impact upon West Beach. As also at the source of dredging.

4. Option 1.1 cannot be assured by future Governments, every 4 h year.

5. Dredging fails 3 of the 3 Review Terms, generates disruption on delivery, does not avoid environmental harm and fails maximising sand staying on West Beach.

6. Option 2.1. Sand Recycling can minimize disruption by equally sharing disruption. Environmental assessment is complete and has pre-approval status. Replicates the successful Glenelg to Kingston Park southern beach recycling pipe system. Importantly offers sand recycling and sharing of sand resources, on a long-term basis.

7. Option 2.1, future ensures by contractual sand delivery into West Beach.

8. Sand Piping passes 3 out 3 of your Review Terms. Minimises Disruption by sharing disruption of sand source locations. Avoids environmental harm seen offshore with a dredging option and ensures environment repair post installation of the pipeline alignment. Equally sand source sites can be readily rehabilitated. Delivery maximises sand staying on the beach.

9. Option 3. A token base Option only. Fails mass fill equilibrium needs at West Beach. Greatly maintains West Beach in a degraded condition only.

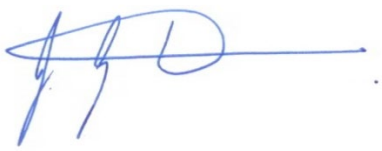
10. Option 3 fails 2 out of Review Terms. Extensive disruption at the sand source, transport routes and delivery beaches. Fails the environment with trucking associated pollutions etc. It can with time maximise sand staying on the beach.

11. EIS Coastal legislation rests with Government. The Review's role is not to make or advise legislation.

With best intentions we trust this submission aids the Panel in considering the best Option for our metropolitan coastline. Requesting the Panel apply science, integrity and understanding, devoid of Politics to benefit all, justly and equally along our coast.

Thank you for your efforts and time in considering our submission.

Yours sincerely



John Dundon
Surveyor.
c/- Save West Beach Sand.
[redacted]



Final Submission to the 2023 Beach Management Review.

Background:
Adelaide's beaches are negatively impacted by a significant northerly littoral drift. The supply of sand is finite, see Hallett Cove. There is only a partial recycling process between Glenelg and Kingston Park. There are three major rock groynes at Glenelg, West Beach Boat Harbour and Outer Harbour, that inhibit the northerly sand migration. Since the construction of the West Beach Boat Harbour in 1998-2000, sand has been mined and trucked to overcome the scientifically proven annual loss of over 100,000 cubic metres of sand from Cell Three. (Boat Harbour to the Torrens Outlet.) The need for this is to overcome the current degradation of beaches at West Beach, Henley South and Henley Beach. During this time little effort has been given to restore the beach profile causing further beach erosion. This has had significant impact on community use of beaches like the need to cancel Surf Club carnivals and limit beach access to Adelaide's busiest caravan park at West Beach Parks. During this time the sand steadily accumulates on all beaches north of Grange to Outer Harbour.

Beach Management Review Findings:
The Government's independent panel along with the assistance of its nominated coastal engineering report from Bluecoast Consulting Engineers clearly identifies that the three groynes are a fixture, the sand accumulates in Cell Six, Semaphore and Largs Bay, and needs to be recycled. It has suggested a number of options.
Many of these options have not been adequately researched due to time and finance although all previous evidence is that no suitable sand for recycling exists in St Vincent's Gulf and that it is unlikely the Environmental Protection Authority would approve, if the sand existed, for dredging.

The continuing of carting sand from quarries is unsustainable and environmentally unsound, leaving only one option. The “back passing pipeline” similar to the process currently operating successfully between Glenelg and Kingston Park. This option is long proven and has had previous support of SA governments, of both political persuasions.

Continuing to delay enacting this option will result in further escalation of public costs and further environmental harm. Now is the time to draw a line in the sand and act on behalf of all of us and further generations.
We need strong Environmental and Political Leadership in 2023 and I strongly support the thoughts of the Advertiser’s Editor, 19/9/23:



Pick the best option to save our beaches

Adelaide’s beaches are a glorious part of the city’s prized lifestyle and important drawcard for visitors.

Longshore drift, or the movement of sand northwards by wave action, means many of these magnificent beaches naturally erode.

Over the years, addressing this has required a mix of dredging, pumping and sand carting. The state government is now wanting feedback on three options for beach maintenance.

It is vital that any decision is guided by the best option for Adelaide’s coastline as a whole, not just which NIMBY groups have the loudest and most politically powerful voices.

The government should listen to people’s arguments but not favour sectional or political interests.

Maintaining Adelaide’s beaches is a costly but important exercise.

Unfortunately, the process will upset some residents but the greater good is magnificent beaches for years to come.

Responsibility for all editorial comment is taken by The Editor, Gemma Jones, 31 Waymouth St, Adelaide, SA, 5000

MAIL: Letters to the Editor, GPO Box 339, Adelaide 5001

Additional Comments:

1. It is pleasing that previous research and decision to use sand pipes for recycling sand along the Adelaide coastline by the Department of Environment and the Coastal Protection Board continues to be endorsed as meeting the Review guidelines and remains as a key recommended option.

2. There is no mention in the findings of the review of the fact that sand appears to accrue at the Torrens Outlet and again between Henley and Grange Jetties near Marlborough Street. It appears to me that the hydraulic groyne at the Torrens Outlet successfully holds sand at West Beach before leaking into the two sand bars before coming ashore at Marlborough Street. This has a significant negative impact on both Henley South and Henley beaches. Occasionally flooding from the Torrens River further exacerbates this action.

3. History continues to tell us to do nothing will result in further deterioration of our beaches. We have also seen the escalation in costs whilst decisions have been delayed. Re-iterating the need for a speedy resolution.

Alan Young
Resident of West Beach and a keen observer of our Coastline.
Charles Sturt Senior Citizen of the Year, 2022
Recipient of a 2023 SA Environment Award, Jill Hudson Award for Environmental Protection.
4/10/23

From: Grant Warner <[redacted]>
Sent: Friday, 6 October 2023 7:13 PM
To: mail <mail@urps.com.au>
Subject: Coastal Sand Management Review

Review Team

My preferred solution is a near shore dredging, pumped onshore, then pumped south.

As a cost and prompt compromise, trucking is acceptable.

I understand offshore dredging is not environmentally appropriate.

I appreciate the cost constraints caused bu reduction in federal taxes in the last 10 years, which is apparent from about 2016 onwards.

Proposal

I suggest dredging around North Haven entranace, then proceeding south along the rock wall and near shore, above the low tide mark.

When Bateman's Bay (NSW) dredged the river entrance, the sand was pumped ashore. They created a reverse sand cone, then pumped wet sand inside the cone. This allowed the sand to dry with sand and water not filtering into the bay.

Knowing the area, a capturing pan will be required, sufficient to withstand storms, or pump it into a carpark.

A similar plan should be instigated at the Glenelg break water / marina entrance.

Significant dredging to a deapth of 2m is required to make a long term difference and to improve safety.

Rocks / Groynes

I have noted that at the eastern beach of Pt Vincent, rocks were intially placed near stairs to reduce erodsion. Over time the rocks have moved and are now spread out. This had improved the sand retention.

I suggest that in places, placing about 20 1m diamter rocks, 1m apart will create areas of reduced sand movement. Which over time will retain sand.

Being 1m apart will not impede beach users.

A locations such as 50m north of the Somerton Yacht Club access point and the Henly Life Saving Club would be ideal trial locations.

Pehaps at Henly, install rocks cover with sand 100m either side and obeserve what happens. Thus having a new and mature site for review.

Grant Warner
[redacted]

Mob [redacted]

I grew up at MorphetVale, holiday at Pt Vincent, and sail in SA regularily, and love SA beaches.

Get BlueMail for Android

Response to the Adelaide Beach Management Review Shortlist of Options, October 2023

Kay Ronai

Semaphore Resident

2023

Introduction

I am an active, founding member of two environmental groups in the Semaphore and Largs Bay area – The Semaphore Largs Bay Dunes Group (SLBDG) and Save Our Shores: Semaphore Largs Bay (aka SOS). SOS was established in response to the Department for Environment and Water (DEW) suddenly informing the public in 2019 that a road would be built though the dunes so that trucks would transport sand to West Beach. Four years later both SLBD and SOS remain key environmental groups, with active community participation, anchored by a deep-seated concern for the future of our beaches.

I am writing as an individual rather than as representative of either organisation. Like many others in our community, I have advocated strongly for an independent review of Adelaide's beaches, as it is clear that the traditional approach of sandcarting from one beach to another is insufficient to deal with the challenges of climate change, and is simply not working.

I thank the Malinauskas government for initiating this review, and the ABMR's considered report on three possible options.

Options 1.1, 1.2, 1.3 - Dredging

Of the three options offered in this report – dredging, pipeline and sandcarting – Dredging is the most suitable, for a number of reasons. It is the most economic of the three options. It appears to be the least disruptive to the communities re their access to the beach. Research and experience elsewhere indicates it is the most effective for keeping sand on beaches. It is the most flexible, allowing sand to be distributed to key hot spots across the Adelaide Metro coast line.

My approval and support of DREDGING is dependent on two conditions:

1. **A comprehensive, rigorous, independent environmental evaluation.** Dredging will have some environmental impact and it is important to have this assessment to ensure least harm and support ways to mitigate this. For instance, we need to strengthen our seagrass beds. We need to ensure that the sand sources around Largs Bay and Outer Harbor or Port Stanvac are the best sources. I am concerned to see Section Bank listed as a possible sand source since this has long been considered ''out of bounds'' as a sand source for West Beach.
2. **Comprehensive, real-time monitoring and reporting arrangements with work to stop if conditions deteriorate.**

I strongly support options 1.1 and 1.2. **but would need further clarification around Option 1.3**, since it does not rule out obtaining sand less than 2 km from the beach. The information provided does not indicate how close to the beach the dredging machinery will be, though at the Stakeholders' meeting there was some verbal assurance that the machinery would not affect the

beaches. In option 1.3, there will still be trucks on the beach, and I wonder if there are less intrusive ways to the beach environment and the community of delivering sand ie. barges.

Although the Bluecoast report rules out seagrass beds and oyster reefs as key options, I would advocate for a multipronged approach, since seagrass and oyster bed reefs are part of the environment's natural defences against environmental harm. So far in South Australia, the seagrass experiments have been low-budget and conducted at a small-scale, depending on volunteers and grassroots organisations to collect and process seagrass seeds around Christmas and New Year when they wash up on shore. In Western Australia, for instance, there are much greater attempts to propagate seagrass areas.

Options 2.1, 2.2, 2.3 Sand Pipeline Variants

An independent Environmental Impact Statement has long been requested for the sand pipeline, and there will be continued community objection to this proposal without that.

I STRONGLY object to all of these pipeline options for the following reasons:

--*The pipeline is expensive, almost double that of the dredging option.* SOS asked a number of times for the maintenance costs of the pipeline, as did the Parliamentary Estimates Committee and were not given the complete picture, so it interesting to see a more realistic costing of the project.

-- *The pipeline (in particular option 2.1) is based on out-of-date, twentieth-century data* that does not allow for climate change. It is a fixed structure at a time when flexibility is all important to weather the effects of climate change, such as storms.

-- *Building the pipeline is intrusive,* cutting through dunes and affecting precious biodiversity of the dunes. What was not in the original pipeline plans that DEW submitted to SCAP was that, for seven months of the year, most of the key carpark near Point Malcolm would be closed to house infrastructure for the key building site offices. We wonder what else was missing from that submission.

--The original SCAP submission for a pipeline focused on Port Malcolm, but it soon became clear on the morning of the SCAP hearing that Hall Street, Semaphore, and Everard Street, Largs Bay, would be key sand-gathering stations for the pipeline for four months of the year. The pipeline processing at Glenelg is intrusive, noisy and ugly. Imagine how intrusive this would be at **three** designated – whether consecutive or simultaneous = places along Semaphore and Largs Bay. The jetties are also key community and tourist centres and the community would not accept the shutting of the jetties for four months.

-- *What the pipeline does not allow for is the effect of climate change and the intensive sandmining on Semaphore and Largs Bay beaches.* Intensive sandmining has lowered the level of Semaphore and Largs Bay beaches, making their dunes more susceptible to the increase in significant storms. The promised replenishment of the beaches over summer has not eventuated and what we see are deeply eroded shorelines and dunes. Long-established planting, essential to dune stability and biodiversity, has now been destroyed. We know this will worsen. The latest data figures at https://maps.dea.ga.gov.au/story/DEACoastlines show that sand is not building up at Semaphore and Largs Bay beaches, as claimed by DEW and other communities. Semaphore Beach has lost 70 metres of coastline since 1993, and Largs Bay has lost 30 metres of coastline since 2016. Sand is not

coming back, despite the theory forwarded that southern sand is moving up to Largs Bay. It would be interesting to track how much of that sand is arriving at Largs Bay, and how much is diverted out to sea. To add to this, the La Fevre Peninsula is one of the areas in Australia most vulnerable to climate change and is sinking. We need our sand.

-- *West Beach deserves better sand than what Semaphore and Largs Bay have to offer.* Quarry sand appears to be more effective in staying at West Beach than the fine sand from Semaphore and Largs Bay, which washes quickly away when dumped on West Beach via trucks. However there needs to be more consideration as to how to stabilise the sand once it arrives at West Beach, and ways of addressing the wave action at West Beach. A pipeline is not going to solve those issues.

-- *Impact of the pipeline on the environment.* There was little mention of the effect of *microplastics and nano plastics* washing into the sea from an abraded plastic pipeline in either DEW's SCAP proposal or here.

-- One of the key criteria of the ABMR was to assess *impact on the communities.* A key proportion of Semaphore and Largs Bay residents are firmly opposed to the pipeline, and the way the beach sandmining has been managed. DEW needs to re-establish trust with communities. The pipeline, as with the sandcarting, has divided beach communities. One only has to look at the Facebook pages of key environmental and grassroots organisations. Dredging provides a reasonable, fresh, more flexible, much cheaper alternative.

Option 3 Sandcarting

There are two parts to this option: sandcarting with the fine sand from Semaphore and Largs Bay, and sandcarting with quarry sand,

Sandcarting with Semaphore and Largs Bay sand

-- I am **firmly opposed** to the current practice of carting beach sand from Semaphore and Largs Bay. This approach may well have served the beaches for fifty years, but climate-change-related extreme weather events indicate the importance of instigating new approaches. The trucks are noisy, intrusive and hated by the community. Agreements have been breached without consultation and respect, and new protocols will be needed to strictly adhered to. A combination of beach sand and quarry sand has been used, for reasons of costs. I am opposed to this since our sand is too fine to be useful.

Sandcarting with Quarry Sand

I would only support sandcarting if appropriate, fuller-grained 100 % quarry sand is used as an interim solution. I would also encourage developing seagrass beds and ways of reducing wave action such as oyster bed reefs.

Both suggestions are far too expensive.

Summary

I **strongly favour Options 1.1 and 1.2 of Dredging options,** with some more clarification around Option 1.3. I am strongly in favour of an independent, extensive environmental impact assessment, even if that takes time, since it is important to ensure the proper management of Adelaide's metro beaches.

I am strongly opposed to options 2 and 3. They are costly, intrusive and will continue to split communities. They are not best practice, nor cost effective.

Please also consider a multipronged approach of cultivating seagrass areas and restoring or rebuilding oyster reefs, nature's way of reducing wave action and erosion.

I am happy to discuss these concerns further with the panel, though will be interstate until the end of October. However I am happy to present online.

From: Kate D <[redacted]>
Sent: Monday, 9 October 2023 5:31 PM
To: mail <mail@urps.com.au>
Subject: Adelaide Beach Management Review Feedback

Beach management review

This review assumes that people care only about the amenity on their small stretch of beach, rather than the overall need to base the solution on what will have the lowest overall carbon emissions, and the lowest overall damage to the environment.

Instead as always, it is about money and votes. So government can be seen to be consulting while really giving no useful information to its citizens

The indicative costs for each of the "solutions" doesn't even factor in climate impacts that will materially increase volumes of sand required for replenishment. This makes the cost comparisons so understated they are meaningless, and in my view paints a dishonest picture of what the future might look like beyond the first few years - irrespective of the option chosen.

Unfortunately admitting past development mistakes that have largely created the issues we have is not politically or socially palatable. It is time the SA govt was far more honest about the reality that some beaches will have to go in the longer term, and potentially some infrastructure unless massive walls are built along the entire foreshore at immense cost.

Instead, the SA Govt conveniently keeps climate change out of scope as this is a far easier solution to model. Insurance companies will be seen as the bad guys who will make beachside living unaffordable for most .

So I can't provide a preferred option as you have not provided a true 20+ year projection of each model that gives me any sense of escalated cost and environmental damage. Getting rid of the West Beach boat ramp seems like a good start, but this of course is not one of the options despite it costing millions to keep the channel cleared and it being a part of the problem.

The answer needs to put far more focus on science and far less focus on this expensive public relations exercise.

Kate and Graeme Denton

From: Dianne Burns <[redacted]>
Sent: Tuesday, 10 October 2023 10:24 AM
To: mail <mail@urps.com.au>
Subject: Adelaide Beach Management Review

Good Morning

In regards to the Adelaide Beach Management

We live along the coast line at West Lakes Shore and i beleive the best option and will give my full support is to the Dredge Barge Variant option

which we strongly support

Strengths: Most Flexible, Least Disruptive to Beach Amenity and Communities, Most Effective for Keeping Sand on Beaches, Most Economic Strategy.

And this will keep trucks off our beaches so everyone can enjoy without having to worry about trucks

Thanks

Dianne and Mark Burns
West Lakes Shore SA

From: Alan O'Connor <[redacted]>
Sent: Tuesday, 10 October 2023 2:20 PM
To: mail <mail@urps.com.au>
Subject: Submission on Sand Management

Good afternoon

I wish to advise that my preference for a solution to the sand management issue is for:

1.1 'Dredging existing sand near the shore'

This appears to be the cheapest option and the one preferred by most locals as it ensures that there are no trucks or pipelines on the beach and minimizes environmental damage.

Regards
Dr Alan O'Connor
Semaphore South

I am a member of the Save Our Shores: Semaphore Largs Bay group. This is a personal submission.

I have been involved in this issue for over 4 years and been a member of the Semaphore Working Group and the Community Liaison Group for the original pipeline proposal. I objected to the planning application for the pipeline.

I strongly support **Options 1.1, 1.2 and 1.3** under the following conditions:

- There is a full Environmental Impact Assessment undertaken before work commences under any of these options.
- Work under these options is sufficiently far from the coast to avoid damage to the beaches.
- Only quarry sand is considered under 1.3 and alternative methods of delivering quarry sand are investigated to avoid trucks on the target beaches. Alternatives may include delivery by barge to the near offshore, a local pipeline or conveyor belts.
- I do not support using Section Bank/Bird Island as a sand source, due to its environmental significance, particularly for migratory bird life.

I strongly oppose **Options 2.1, 2.2 and 2.3** because

- There will be severe environmental damage to the source beaches and associated dunes.
- There is no flexibility of sources and there will be a temptation for future administrations to significantly increase the amount taken from the source beaches.
- The options are expensive.
- Micro-plastic contamination of the target beaches is a real problem over the 20 year use of a plastic pipe to carry sand.
- The sand grain size of the source beaches under these options is less than ideal to maintain sand on the target beaches, particularly under storm conditions.
- Access to some of the most popular beaches on the Adelaide coast, serving the northern and north-eastern suburbs will be interrupted for significant periods of time. These are also popular tourist destinations.
- Increasing sea levels, land subsidence and more frequent storm events mean that dune and beach integrity of possible source areas is vital as a first line of protection for infrastructure.

I do not support Option 3 **as stated**.

However, I do support the use of appropriate quarry sand, particularly as an interim measure. More work needs to be done on this option (see appendix).

In summary, I support the dredging options under certain conditions. I oppose the pipeline options. I support further research being done on quarry sand as a source.

Warwick Norman

Semaphore

October 9th 2023

Appendix.

Quarry Sand

Quarry sand does not have to be delivered onto the target beach by truck. Alternative methods of delivery could be used. (See Option 1.3 above.)

More work needs to be done on this option. It is clear that quarry sand is less likely to wash away from the target beach, particularly during storm events.

For an informative article on using coarser sand, see

https://www.abc.net.au/news/2018-09-26/coarse-sand-quarried-onshore-would-help-west-beach-sand-drift/10303670

The Adelaide Living Beaches Technical Report (p 126) indicated that storm-induced erosion was reduced by up to 80% if 0.5mm sand replaced the current 0.22 mm sand.

The DHI *2023 Update of the sand volume analysis along West Beach* indicates the addition of coarser quarry sand may have reduced the erosion at West Beach. Further work needs to be done on this. If there is, in fact, reduced erosion due to coarser quarry sand, then it may indicate reducing costs of replenishment over time. More work should be done on this possibility.

The cost of quarry sand is important in this discussion. Over 4 million tonnes of non-coastal sand is mined in SA every year. The value for royalty payments is around $11 per tonne. Whilst the pipeline was the focal point of DEW's attention, there seemed to be little work being done on investigating lowering the cost of quarry sand. Long-term contracts, exploring diverse sources and alternative delivery methods might all significantly reduce costs.

From: Warwick Norman <[redacted]>
Sent: Wednesday, 11 October 2023 9:20 AM
To: mail <mail@urps.com.au>
Subject: Adelaide Beach Management Review

Hi
Below is my submission to the current stage of the Adelaide Beach Management Review. I am also attaching a copy.
Regards
Warwick Norman

I am a member of the Save Our Shores: Semaphore Largs Bay group. This is a personal submission.

I have been involved in this issue for over 4 years and been a member of the Semaphore Working Group and the Community Liaison Group for the original pipeline proposal. I objected to the planning application for the pipeline.

I strongly support **Options 1.1, 1.2 and 1.3** under the following conditions:

- There is a full Environmental Impact Assessment undertaken before work commences under any of these options.
- Work under these options is sufficiently far from the coast to avoid damage to the beaches.
- Only quarry sand is considered under 1.3 and alternative methods of delivering quarry sand are investigated to avoid trucks on the target beaches. Alternatives may include delivery by barge to the near offshore, a local pipeline or conveyor belts.
- I do not support using Section Bank/Bird Island as a sand source, due to its environmental significance, particularly for migratory bird life.

I strongly oppose **Options 2.1, 2.2 and 2.3** because

- There will be severe environmental damage to the source beaches and associated dunes.
- There is no flexibility of sources and there will be a temptation for future administrations to significantly increase the amount taken from the source beaches.
- The options are expensive.
- Micro-plastic contamination of the target beaches is a real problem over the 20 year use of a plastic pipe to carry sand.
- The sand grain size of the source beaches under these options is less than ideal to maintain sand on the target beaches, particularly under storm conditions.
- Access to some of the most popular beaches on the Adelaide coast, serving the northern and north-eastern suburbs will be interrupted for significant periods of time. These are also popular tourist destinations.
- Increasing sea levels, land subsidence and more frequent storm events mean that dune and beach integrity of possible source areas is vital as a first line of protection for infrastructure.

I do not support Option 3 **as stated**.

However, I do support the use of appropriate quarry sand, particularly as an interim measure. More work needs to be done on this option (see appendix).

In summary, I support the dredging options under certain conditions. I oppose the pipeline options. I support further research being done on quarry sand as a source.

Warwick Norman

Semaphore

October 11th 2023

Appendix.

Quarry Sand

Quarry sand does not have to be delivered onto the target beach by truck. Alternative methods of delivery could be used. (See Option 1.3 above.)

More work needs to be done on this option. It is clear that quarry sand is less likely to wash away from the target beach, particularly during storm events.

For an informative article on using coarser sand, see

https://www.abc.net.au/news/2018-09-26/coarse-sand-quarried-onshore-would-help-west-beach-sand-drift/10303670

The Adelaide Living Beaches Technical Report (p 126) indicated that storm-induced erosion was reduced by up to 80% if 0.5mm sand replaced the current 0.22 mm sand.

The DHI *2023 Update of the sand volume analysis along West Beach* indicates the addition of coarser quarry sand may have reduced the erosion at West Beach. Further work needs to be done on this. If there is, in fact, reduced erosion due to coarser quarry sand, then it may indicate reducing costs of replenishment over time. More work should be done on this possibility.

The cost of quarry sand is important in this discussion. Over 4 million tonnes of non-coastal sand is mined in SA every year. The value for royalty payments is around $11 per tonne. Whilst the pipeline was the focal point of DEW's attention, there seemed to be little work being done on investigating lowering the cost of quarry sand. Long-term contracts, exploring diverse sources and alternative delivery methods might all significantly reduce costs.

72 Woodville Road, Woodville, South Australia 5011
PO Box 1, Woodville SA 5011
T: 08 8408 1111 F: 08 8408 1122 charlessturt.sa.gov.au

12 October 2023

SUBMISSION –
Adelaide Beach Management Review (Phase 2) October 2023

The City of Charles Sturt
By Email to mail@urps.com.au

The options presented in the Discussion Paper and the draft Technical Report, provide Council and our community with the opportunity to consider a number of management options for the long term sand nourishment for our beaches.

The accessibility of our beaches for local residents, the wider community and tourists to our region impacts the health and wellbeing of so many. Our local businesses heavily rely on a healthy beach which creates a destination for so many. Our lifesaving clubs provide a hub for social cohesion, support and provide critical lifesaving service to our community. These buildings and services cannot be compromised.

The City of Charles Sturt has some 11.5km of coastline including beaches and sand dunes from Semaphore Park to West Beach. Our dune and coastal zone is the buffer between the land and sea. It's a special place to live, play and relax, however our community is at risk of losing this resource in the very near future.

Current management practices

Beach levels along our shoreline have been actively managed by the State Government since the 1970s, most recently (until 2022) through the Adelaide Living Beaches Strategy. The current management program now includes the placement of sand nourishment at a number of erosion hotspots and occurs on a reactive basis to protect the assets immediately behind the depleted sand dunes.

Trucking, sourcing quarry sand and reactive management to storm damage, has do date been a short-term solution to a long term problem. Trucking of sand and sourcing external quantities to nourish our beaches has proven not to work.

Our beaches are disappearing, and this current program is not enough.

A permanent and long term, scientific solution to sand nourishment along the entire metropolitan coastline must be finalised, resourced and prioritised, before more damage is done.

Approximately 115,000m3 of sand moves to the north along our coastline annually in association with longshore drift. This net northerly movement is primarily due to the predominance of south-westerly swell and waves arriving at an angle to the shoreline. Analysis of the West Beach cell suggests a potential longshore transport capacity of

115,000m3 per year (DHI 2018). This analysis also tells us that the longshore transport rates in the adjacent Henley Beach cell is of the same magnitude. This analysis and science, clearly explains the quantities of sand critical within these locations.

Sand nourishment management programs must cater for these quantities and must be permanent and sustainable in terms of their technology and sand sources.

Beach widths can only be achieved through appropriate sand nourishment and management practices, and they play a significant role in shoreline protection, providing adequate 'buffer' to counter the erosion processes. Importantly it is not only the above water mark but also the below water mark sand profile that is critical to this.

The preferred options

Initial mass nourishment to bring the beaches back into equilibrium will ensure our beach profiles, dune systems and access can all occur and that the depleted system begin to be replenished to a point where it can recover and be managed sustainably.

To ensure the long term and permanent management of our beaches, a sand pipeline must be part on the solution. Councils preferred and strongly supported options are therefore Options 2.1 and 2.3 as proposed in the Discussion Paper. Option 3 is supported – but only as an option of last resort.

Council remains neutral in relation to the solutions proposed in options 1.2 and 1.3. We acknowledge that these options could potentially work, however based on current investigations undertaken to date and presented to the community for the purposes of consultation, remain hypothetical. To be supported, a source of sand must be technically confirmed within the next 6 months. Further consideration should be given to recognising the regulatory hurdles these options must address (EPA Dredging License, Environmental Impact Statement etc) and until such time as these matters are confirmed, these remain tenuous solutions.

It is recognised that benefits of dredging to all communities would be ideal, however without the long term certainty in place, uncertainty prevents informed decision making.

Options 1.1 and 2.2 are strongly not supported.

Deleted: 1

The pipeline must be put in place to ensure sand nourishment, beach equilibrium and minimal disruption for beach users and residents is provided.

There may be compromises to be made throughout the process, such as during construction or throughout sand nourishment activities and also some compromise to the visual amenity in some locations should permanent or temporary infrastructure be required. Where environmental damage does occur a concerted effort and part of the program to repair that

damage must occur. It is understood that this may be necessary to ensure our beaches are maintained for social, economic, and environmental sustainability well into the future.

The City of Charles Sturt would also like to publicly speak to our survey response and written submission at a meeting of the Independent Advisory Panel (IAP) with nominated representatives to present to the panel being; Cr Kenzie van den Nieuwelaar and CEO Paul Sutton.

Resources

DHI (2018) West Beach Coastal Processes Modelling, Assessment of Coastal Management Options Final 2.0. Prepared for Department of Environment Water & Natural Resources

From: kristin vonney
To: mail
Cc: kristin vonney
Subject: Attention: Adelaide Beach Management Review
Date: Friday, 13 October 2023 3:02:40 PM

To whom it may concern
I have made detailed comments in the survey but below are additional comments.

Regarding the goals of the Adelaide beach management review:
1. Maximise sand staying on beaches
Past practices in beach management have denuded sand from Semaphore and Largs Bay and if the pipeline or carting options get up this will continue. This is not 'maximising sand on all beaches'.
The littoral drift of sand from south to north has NOT resulted in a build up of sand on Henley North, Semaphore and Largs Bay beaches. 2022 DEA CSIRO satellite imagery shows that over the last 30 years, 30m of beach has been lost from Largs Bay and 70m of beach has been lost from Semaphore. These beaches cannot be used as sand mines; it is destructive and clearly not sustainable.
Sand grain size at Largs Bay is not large enough to remain on West Beach once it has been deposited.
Dredging options place sand near the shore of West Beach and allows nature to build up the beach profile and maximises sand staying on the beach.

2. Minimise disruption for communities
Dredging does not require heavy machinery on beaches meaning less disruption for communities and beach users.
The pipeline would maximise disruption for communities due to tractors, trucks and heavy machinery being on beaches during installation, operation and maintenance. This will impact beach users, businesses and tourism for the state.
The current practice of moving sand using trucks and machinery is dangerous, noisy, polluting and intrusive. It impacts beach users, businesses and tourism for the state.

3. Avoid environmental harm
A pipeline would cause serious environmental damage including: destruction of nesting and foraging areas of threatened species, destruction of protective dunes and ***high quantities of micro and nanoparticles would be delivered to the beach and into gulf waters.***
Moving sand using trucks and machinery is dangerous, noisy and polluting.

Kristin Vonney

Adelaide Beach Management Review

Options Shortlist Submission

By Carol Crossley

Sandpiper Dune Care Group

9/10/23

The 3 options put forward by the Management Review Committee are as follows:

- Options 1.1, 1.2, 1.3 Dredge Barge Variants
- Option 2.1, 2.2, 2.3 Sand Pipeline Variants
- Option 3: Trucking sand from Beaches and Quarries

My views are strongly held and have been formed after considerable research and discussion.

OPTIONS 1: Dredge Barge Variants - STRONGLY SUPPORT

I favour options 1.1, 1.2 and 1.3 Dredge Barge Variants over the others because:
Option 1 is:

- Most flexible and sustainable in the long term
- Least Disruptive to Beach Amenity and Communities,
- Most Effective for Keeping Sand on Beaches,
- Most Economic Strategy,
- Most Up to date, evidence based Information from around the world
- Potential for "Training Academy" at Port Adelaide to support Dredging strategy and longer term marine associated industry,
- Most Environmentally Friendly
  - **Major Proviso**: In recent years, tighter control of dredging in the form of strict regulations, enforcement and monitoring, and mitigating measures together with proper impact assessment and development of new environmental dredging techniques has helped to prevent or minimize adverse impacts on seagrasses.

Option 2. Sand Pipeline Variants - STRONGLY DO NOT SUPPORT

Because:

- Technical viability of sand pipe is suspect,
- Cost over the long term,
- Sand budget imbalance,
- Degradation of northern beaches from sand planes and trucks,
- Sand grain size at northern beaches is too small and of poor quality (high calcium carbonate) for this pipeline initiative,
- Open space amenity being lost due to infrastructure,
- Social anxiety caused by noise and disruption due to trucks and sand planes,
- Back-end maintenance costs and decommissioning costs,
- Potential for "asset" to be stranded after decommissioning,
- Micro and Nano sized plastic particles caused by abrasion of the pipeline washed into the marine food chain,
- Disruption to wildlife eg Hooded plovers nesting on beach (Trucks can run over the birds or crush their nests),

- Disruption to habitat eg snakes and lizards who live in the dunes (Truck noise can frighten them, distorting their breeding cycles).

Option 3. Trucking from Beaches and Quarries

I do not support the option of trucking sand from Beaches because:

- Robbing any beach of sand to transport onto another is not changing what we are doing now and history shows it does not work!
- Depositing sand at base of dunes makes it vulnerable to it being washed away at first high tide,
- Very disruptive to residents, flora and fauna,
- Dangerous as trucks on beaches are hazards to people, dogs, Hooded Plover birds and the environment,
- Diminished amenity associated with visual impact and noise pollution,
- Deisel fumes from trucks.

I do not support the option of trucking sand from Quarries in the long term because:

- Trucks will still be on roads and beaches, causing deterioration of roads and placing deep ruts in sand,
- Temporary mining of suitable sized grain quarry sand is preferable to any mining of beach sand, in the short term to supplement the Adelaide Beaches "hot spots" with sand. This should ONLY be used as an emergency solution (Bandaid) with other strategies eg dredging and barging used for the long term.

In Conclusion:

The Government's 3 goals of maximizing sand staying on beaches, avoiding environmental harm and minimizing disruption to communities are lofty. Coupled with the effects of climate change we are faced with the need to arrive at potential solutions which may be new to the Coastal Protection Board and possibly the Management Review Committee as well.

We need to look at options that are independent, reviewed, evidence based and best practice.

Every beach is important! Every area should be looking at the whole coast and not just focusing on their own patch.

We need to build collaboration between groups to ensure the success of this initiative now and into the future.

Adelaide Beach Management Review
C/- DEW

To whom it may concern

Asa resident of Largs Bay I am strongly opposed to options 2.1, 2.2 and 2.3 – in fact any and all options which are touted and may be proposed in the future to the building of a Pipeline involving the quarrying of sand from Largs North, Largs Bay, Semaphore and Semaphore South beaches.
The detrimental effect of the already undertaken carting works is plain to see in the lowering of the littoral drift and destruction and erosion of established sand dunes.
It beggar's belief that the removal of said sand has not been retained in some form of built groyne scenario– employed successfully worldwide.

The actual process of removing the sand from these beaches has proved to have a detrimental affect on the health and well-being of a large proportion of not only local residents and families but tourists, retailers, and conservationists who frequent them.
The noise has been so intense that I have discussed fitting double glazing to my house windows however that would not defray the constant and persistent drone of loud sand moving machinery and associated working vehicles outside the residence.
This noise continued for at least four months on one occasion and is completely unacceptable.

Sand, as such, is one of the world's greatest and most valuable commodity and should not in any circumstances be regarded as Sacrificial as seems to be the case with West beach.

Options 1.1 and 1.2 (Dredging) are a possible answer at 2km offshore but an Environmental Impact Statement would be required.

Option 1.3 (Dredging) is questionable as no minimum distance from shore is specified.

Certainly the North Haven Beach waters act as a catchment area for not only drifting sand but also it is where the sand is placed when the entrance to the CYCSA is dredged thus resulting in an almost lagoon state.

It has been suggested that this area be dredged but was met by some resistance by DEW from a cost perspective – in light of proposals this may be reconsidered.

Option 3 (Carting) would only be acceptable if 100% Quarry sand was used ie NO Beach Sand!
To this end I understand that a large quantity of quarry sand is available and could be used but once again it should not be Sacrificial- measures to retain need to be augmented.

It is of concern that there is only a limited amount of new sand entering the Adelaide beach system and as such the management of protecting homes, infrastructure and businesses from detrimental storms and larger than normal king tides is paramount.

I reiterate that methods of retaining the sand need to be augmented otherwise any of the options chosen will be fruitless.

Yours sincerely

Ms Karyn Holloway
[redacted]

SUBMISSION PAPER

Submission on shortlisting options
Adelaide Beach Management Review October 2023

1. Introduction

The City of Port Adelaide Enfield (CPAE) welcomes the review of sand management options and the role of the Independent Advisory Panel in providing expert and independent advice to the Minister.

A submission on Stage One of the review process was provided in June 2023. This submission to Stage Two of the review process builds on feedback provided in the previous submission and specifically discusses the shortlisted management options.

2. Feedback on Short List

Our assessment of the shortlisted options uses the below criteria which are based on Council's existing positions on this matter and reflect the issues raised in the Council's early submission to the Adelaide Beach Management Review:

1. **Supports an adaptative management and whole of system approach to the management of Adelaide's Beaches**
2. **Excludes the need to extend the existing pipeline to Largs Bay and Semaphore.**
3. **Minimises impacts on:**
   a) **public safety** (i.e., truck movements on beaches and in suburbs and construction of trenches in the intertidal zone);
   b) **public amenity** (i.e., noise and nuisance impacts);
   c) **the natural environment** and coastal erosion (on the dune and beach environments and habitats and coastal erosion of the dunes);
   d) **the local economy** (i.e., role of beach, dunes and foreshore in visitor economy and supporting local business activity)
   e) **the role of the coast in identity of place** (i.e., activation of beach and community activities in dunes and foreshore)

Option	Assessment against criteria	Council position
1.1 Dredge existing sand near shore	This option would negate the need for the installation of a pipeline from West Beach to Largs North and does not require land-based truck movements on beaches or local roads. Environmental and noise impacts required further technical investigation.	Conditional support subject to: • further investigation of the required sand sources and volumes to ensure environmental impacts on the marine environment (including seagrasses) and coastal processes and noise impacts are minimised; and • completion of the economic analysis.
1.2 Dredge using large offshore sand deposits	This option would negate the need for the installation of a pipeline from West Beach to Largs North and does not require land-based truck movements on beaches or local roads. Environmental and noise impacts require further technical investigation. Environmental impacts on shorebird habitats need to be avoided.	Conditional support subject to: • the exclusion of the Section Bank/Bird Island as a potential sand source; • further investigation of the required sand sources and volumes to ensure environmental impacts on the marine environment (including seagrasses) and coastal processes and noise impacts are minimised; and • completion of the economic analysis.
1.3 Combination of dredging offshore deposits and trucking sand deposits	This option would negate the need for the installation of a pipeline from West Beach to Largs North and does not require land-based truck movements on beaches or local roads in the City of Port Adelaide Enfield. Environmental and noisimpacts require further technical	Conditional support subject to: • the exclusion of the Section Bank/Bird Island as a potential sand source;

Option	Assessment against criteria	Recommended position
	investigation. Environmental impacts on shorebird habitats need to be avoided.	• further investigation of the required sand sources and volumes to ensure environmental impacts on the marine environment (including seagrasses) and coastal processes and noise impacts are minimised; and • completion of the economic analysis.
2.1 Pipeline using tractors/trucks on beaches	The use of pipeline is contrary to Council's resolution of 13 June 2023.	Not supported.
2.2 Pipeline using fixed jet pump systems on jetties	This option includes location of plant machinery on local jetties in winter months when the jetties are subject to increased risk of storm damage. This option also impacts negatively on public amenity and the local economy (i.e., access to jetties). The use of pipeline is contrary to Council's resolution of 13 June 2023.	Not supported.
2.3 Pipeline using a temporary dredge	The use of pipeline is contrary to Council's resolution of 13 June 2023.	Not supported.
3. Maintain current arrangement: moving sand using trucks and machinery and external quarry sand	This option relies on extracting and trucking sand from the beaches and intertidal zone and increased trucks movements along the local road network, with resultant public safety, public amenity, economic and environmental impacts.	Not supported.

Council's conditional support for the dredging options listed above is contingent on the findings from further technical investigations and environmental assessments. **The fact that the full technical assessment of the shortlisted options was not released at this stage of the engagement (due for release in mid – October 2023) has limited Council's ability to provide unconditional support for any of the shortlisted options.**

Council is committed to supporting a whole of system and adaptive management approach to the management of Adelaide's beaches.

3. Opportunity to Speak to Submission

The City of Port Adelaide Enfield would like to publicly speak to our written submission at a meeting of the Independent Advisory Panel (IAP).

Adelaide Beach Management Review

Shortlisted Options Submission

Semaphore Largs Dunes Group (C/O Sandra Dann) October 2023

Introduction

Semaphore Largs Dunes Group (SLDG) has previously submitted to the ABMR and this submission addresses the short-listed options. With adjoining groups Taperoo Dunes Group, Friends of North Haven Dunes and PAREPG (Port Adelaide Residents Environment Protection Group) SLDG has enjoyed an investment by Government via the Green Adelaide Grassroots Grants of $150,000 over the last 3.5 years. Significant efforts are being made to create a Green Biolink around the Lefevre Peninsula which will become a major environmental asset for this region. Volunteers are committed to preserving this unique dune system. They are investing hundreds of hours of work with the support of Green Adelaide and City of PAE to remove invasive plant species and increase biodiversity by planting native species.

SLDG supports the dredging options 1.1, 1.2 and 1.3 (subject to environmental assessment and approvals) because:

- They will allow the local beach/dune system to recover from the disruption of heavy vehicles, sand removal and the resulting storm damage of recent years,
- Without further disruption the beach/dune system will have sufficient space to adapt and stabilise to be an effective part of future coastal protection strategies,
- They will give SLDG confidence to continue regenerative work and provide an opportunity to encourage the shorebirds back to the area without the threat of it all being destroyed again with heavy vehicle movements and sand removal.

SLDG wishes to speak to this submission at a meeting with the Independent Assessment Panel.

Contact: Sandra Dann, SLDG Co-ordinator [redacted]

General comments:

1. **Adherence to the scope of the review ie how to manage sand on Adelaide's beaches to minimise disruption for all communities, avoid environmental harm and maximise sand staying on beaches**. The technical report provided contains no evidence of how the social impact of beach management has been measured to date. No model of community tolerance has (to our knowledge) been used to accurately assess 'the disruption for all communities'. No evidence is presented to show what weighting will be applied to survey results and how the survey results and written submissions can be considered an accurate representation of the impact on communities of any of the shortlisted options. Nor is there evidence of how any of the options proposed will maximise sand staying on beaches. All options appear to carry the risk of causing environmental harm, although not enough data is available to date to adequately assess the dredging options 1.1, 1.2 and 1.3.

SLDG question how well the proposed short-listed options adhere to the terms of the review.

2. **No current study of the impact of past sand campaigns on the loss of foredunes, the impact of breaches on dune stability and loss of plant species nor the creation of scarps has been provided for the northern beaches.** 2 years of sand mining has resulted in a disturbing weakening of the dune system with no sign of recovery. Any further taking of sand off northern beaches is opposed as are the pipeline options 2.1, 2.2 and 2.3.

3. **There appears to be a lack of consideration of the ongoing impacts of climate change with rising sea levels, the increased frequency of storm events and the impact of more northerly prevailing winds.**

4. **There is no evidence that environmental harm from microplastics and nano plastics has been fully assessed.** This is particularly relevant for the pipeline options 2.1, 2.2 and 2.3.

5. **The proposed pipeline extension to Largs has not been adequately consulted on with the Largs community.** It was a last-minute addition prior to stakeholders presenting to the SCAP and just prior to the March 2022 State election. There has been no proper community engagement about this. SLDG has always strongly opposed the proposed pipeline options and further opposes the proposed Largs extension.

6. **The independent review has been limited in its scope, relying on existing reports and data provided by DEW but unable to conduct its own feasibility studies into alternative options to the pipeline.**

7. **SLDG fears that if further investigation of dredging options and suitable sand sources knock out dredging as an option then by default we are left with a pipeline and/or trucks and equipment on beaches.** There is no indication of what Government is prepared to spend on managing Adelaide's beaches. Pipeline costs in the shortlisted options appear to have been more realistically costed by this review and prove to be far more expensive than dredging options and yet the Murray Mouth source of sand is not being considered because of the cost factor. There is no evidence of how a cost benefit analysis has been applied to arrive at the short list of options. What is the cost benefit of having attractive, sandy beaches with fully formed foredunes to health and wellbeing, local businesses, tourism, community resilience and local infrastructure? Quarry sand is expensive and so too are the contractual obligations regarding trucking. Clearly the Government considers that the ongoing dumping of sand on West Beach from northern beach sand and quarry sources is feasible (at great expense), even when the sand immediately is washed away. A more long-term sustainable solution has been removed from consideration at this stage.

8. **The aim of achieving harmony along the coast and between beach communities requires much more than words and a technical assessment.** There has been a serious disregard and underestimation of community trust levels in government due to prior practices, undertakings that were then breached, poor management of contractors, ongoing visible damage to beaches, a silence around climate change strategies to accompany this review and past non-disclosure of information, lack of resourcing to properly engage and consult as well as poor survey design.

Options 1.1, 1.2, 1.3 (Dredging)

SLDG supports these options subject to further investigations and environmental impact studies because they:

- provide more flexibility than the fixed infrastructure of a pipeline
- do not require major disturbance to construct infrastructure
- do not take sand directly off beaches
- cause less disruption to communities and beach and jetty use
- appear to be more effective for keeping sand on beaches
- are cheaper than other options
- do not leave a stranded asset at the end of life
- will not produce the level of microplastic and nano plastic pollution that the pipeline will

Options 2.1, 2.2, 2.3 (Pipeline)

SLDG strongly opposes these options. Nothing new has been proposed that would cause acceptance of any of these options – in fact as more information is provided opposition grows for these reasons:

- the proposed extension to Largs has not been adequately canvassed with the local and beach using community
- the proposed extension doubles the impact on the Semaphore Largs communities with increased infrastructure, noise, beach access difficulties, proposed jetty closures for 4 months of each year, continued trucks and equipment on beaches, threats to nesting birds, negative impacts on the intertidal zone, loss of valuable plants from the foredunes and the threat of poor subcontractor behaviour
- the ongoing impact on foredune and biodiversity loss of taking more sand over a 20 to 25 year period
- the pipeline is a fixed structure with limited capacity to be flexible
- the impact of microplastic and nano plastic pollution
- these options mean the northern beach communities are disproportionately experiencing disruption

Option 3 (Trucking sand from quarries and beaches)

SLDG do not support these options because:

- there is current large-scale sand and foredune loss resulting in unsafe and fragile scarps which increase the likely impact of storm surges, breaches and biodiversity loss.
- according to data (2022 DEA CSIRO satellite imagery), Adelaide's beaches are losing sand. To continue to remove more sand and expose beaches and foredunes to the impacts of weather events does not fit with the terms of the beach management review
- taking sand from beaches does not avoid environmental harm and disproportionately disrupts the community

SLDG provides limited support to the use of quarry sand as a last resort at times of crisis only.

Bernadette Cranwell
Henley Dunes Care Group

Resident
[redacted]

12th October, 2023

ADELAIDE BEACH MANAGEMENT REVIEW

Dear URP, Bluecoast engineering & members of the IAP

As a long term resident of Henley Beach South (43 years) and co-ordinator of the Henley Dunes Care Group, I am deeply concerned by the erosion issues that are occurring at West Beach, Henley Beach South and Henley Beach and the ongoing issue of sand loss. I have been actively involved on previous review committees and now as a stakeholder for this review

Yoursay survey and request to be heard by the Review Panel to expand upon the survey and submission.

We acknowledge that Bluecoast Consulting Engineers have overseen the scientific appraisal of options and that URPS have undertaken community engagement. In addition we are aware that an Independent Advisory Panel will oversee the review and make recommendations to the Governmennt.

At this point in time the community has been presented with `draft shortlisted options'. As one of the stakeholders, I and another Henley Dunes Care Group representative attended the Bluecoast presentation on the 27th September. As local residents we have been actively engaged in seeking a solution to the erosion and loss of sand to the north that has been occurring on the Central beaches, i.e. West Beach, Henley Beach South and Henley Beach, for many years.

Bluecoast Consulting Engineers have put forward three main options for consideration, as a 20 year management solution to Adelaide's coastal erosion issues, we will address these in the following document.

Preamble

For the last 50 years Adelaide's beaches have been managed, but never more so than since the 70's with population growth, development along our coast and the building of coastal infrastructure such as the Glenelg Marina, the Boat Harbour, the Sand Pipe system between Kingston Park and Glenelg. Much of this has altered the coastline and has impacted on how sand moves along our coast. Many studies have been undertaken to understand the stressors that impact on the Adelaide Coast, to gain a better understanding of why it continues to be in such a degraded state and why we are steadily losing seagrasses. Some of these studies have included the the Adelaide Coastal Waters Study and Adelaide Coastal Waters Water Quality Improvement Plan, plus there are ongoing projects to seed and nurture seagrasses in our waters.

In the Summary of the Adelaide Coastal Waters Quality Improvement Plan it states:

`Taken collectively all previous work leading up to and including the Adelaide Coastal Waters Quality Improvement Plan has led to one simple but inescapable conclusion: all the things that we value for the region are fundamentally dependent upon improving coastal water quality.' p.23

In addition to improving coastal water quality, one of the most difficult problems has been solving the ongoing erosion and sand loss through littoral drift to the north, that threatens the ongoing future of Cell 3 (West Beach) and also beaches further north, such as Henley Beach South and Henley Beach. (Cell 4)

West Beach, Henley Beach South and Henley Beach

Following decades of sand loss and severe erosion issues at West Beach, the Department of Environment, Water and Natural Resources (DEWNR), Charles Sturt Council and West Beach Parks commissioned the Danish Hydraulic Institute to undertake a study into the sand and seagrass wrack movement at West Beach to address a shortfall in the underlying data on which the Adelaide Living Beaches (ALB) strategy was based. The report documents the investigation undertaken to evaluate the causes of the erosion issues at West Beach and puts forward some management options to mitigate these problems.

In the DHI report it states:

`The accelerating declines in the volume of the West Beach cell from 2005 onwards are clearly evident, even at the entire littoral system scale. An equivalent volume of sediment eroded from the West Beach cell over these periods has accreted in cells 6 & 7 (Largs Bay & North Haven), at the end of the littoral system. Net accretion at a rate of approximately 100,000 m3/yr is also typically observed at the northern end of cell 4 (Henley Beach) and in cell 5 Semaphore Park).' p.20

It is important to recognise that our coast is one long coastal system and that West Beach, Henley Beach South and Henley Beach are essentially connected.

The DHI report recognizes this and in the section `Selection of Management Options for West Beach' it states:

- *All management options would require a significant initial nourishment campaign to restore littoral volumes in the West Beach cell and improve beach amenity and erosion buffers; p. 21*

It goes on to state that this would need to recognise that beaches further north, such as Henley Beach South and Henley Beach would also need nourishment.

- *All management options would need to provide for the ongoing supply of sediment to the **downdrift Henley Beach cell,** to ensure the erosion impacts observed at West Beach were not simply moved downdrift over the longer term.* p.22

This erosion and sand loss is **now occurring** for Henley Beach South and Henley Beach and there has been significant sand loss and erosion issues.

The DHI report goes on to categorically state:

`More specifically, the option would require approximately 500,000m3 of sand to nourish the West Beach cell and 300,000m3 of sand to nourish Henley Beach South to restore the littoral volumes back to the late 1990/s cell volumes.' p.23

Henley Beach South and Henley Beach are not mentioned in this Bluecast report even though these beaches remain seriously eroded, have experienced significant sand loss and beach degradation and infrastructure has been put at risk.

Henley Beach South has been subject to severe erosion and sand loss. Following sand deposits to West Beach, sand has moved across from West Beach but only to the southern area of Henley Beach South. This is due to the fact that Henley Beach South is seriously out of equilibrium with significant sand loss. Sand currently moves from West Beach and by passes Henley Beach South and Henley Beach to be deposited at Marlborough Street, the next beach that is in equilibrium. As a result **Henley Beach South** and **Henley Beach** are **not** receiving the sand nourishment that these beaches need.

During this year **Henley Beach South** has consistently had a wet beach, or no beach. The dune system has been eroded away. Infrastructure has been impacted upon. Joe's Cafe has become severely eroded. The Henley Beach Surf Lifesaving Club has had to cancel programs due to there not being enough sand and levels being down to clay and rocks. Stairwells and ramps have been closed due to not enough sand and dangerous conditions. It has been very difficult to access the beach.

NO ACCESS for independent sand delivery to Henley Beach South

In addition to the above, **Henley Beach South** has no road access for sand to be delivered directly to the beach and is dependent on sand coming across the Torrens from West Beach. This is often problematic, particularly when there are strong flows from the Torrens River or storm activity.

In addition the highly endangered Hooded Plovers nest in this area between August and May and a constant convoy of trucks and sand mining in this area not only causes environmental harm but impacts upon their chances of survival.

We believe that the Torrens Outlet area should be left untouched for the support of water birds and birds such as the Hooded Plover who require estuarine conditions for their survival.

Dredging

Options 1.1, 1.2, 1.3 and variations which use a combination of dredging and the sand pipe have the potential to create serious environmental damage along our coastline. It is also unlikely that these options will receive approval from the EPA.

`The state's marine waters are among the most biologically diverse and unque in the world, with many endemic species and internationally and nationally important species. South Australia's estuarine, coast and marine areas and resources are highly valued by the community and are critically important economically, recreationally and culturally'. (EPA, 2002)

There are many serious environmental impacts from dredging.

- Dredging has the single largest impact on the benthic sea floor community as far as obtaining and depositing sand goes.
- Dredging turbidity strongly impacts on seagrasses that thrive in a light filled environment. They are particularly sensitive to turbidity.
- Offshore deepening also increases wave action. The result of this will be that we will need even more sand to replace the speed of littoral drift
- placing sand near to shore will speed up loss of sand to the north via littoral drif

Port Stanvac

Recent studies have identified that Port Stanvac is unsuitable as the sand source,

In the`Summary of Investigations: Port Stanvac Offshore sand deposits' (Department of Environment and Water) it states in the conclusion:

`Following the completion of the technical investigations at Port Stanvac, the specialist investigators attended a symposium convened by the department to discuss the results of their investigations, the quality and quantity of sand in the offshore sand deposits at Port Stanvac, and the potential risks associated with dredging the sand and pumping it ashore at West Beach.

Based on this analysis of potential dredging risks and the properties of the sand that could be delivered to West Beach, the department has concluded that the Port Stanvac sediments are not suitable or adequate for replenishment at West Beach'.

From this recent research and Government report it is apparent that this sand source will not be available.

Section Bank

This area, is subject to a quarantine exclusion zone as a result of the viral Pacific Oyster Mortality Syndrome (POMS). This makes it unsuitable for dredging UNLESS a treatment and resolution is found for POMS and it is given approval from EPA.

Unknown source

It is difficult to comment on a sand source that is hypothetical. `one additional marine sand souce being realised and being available for use as a borrow area within 5 years (2029)

For many years we have witnessed the destruction of our beaches while we have waited for this problem to be resolved. We need certainty and action, not prolonged delays and the prospect of no resolution.

We do not support dredging.

Climate Change:

In addition to the above Climate Change is upon us. Many innovative projects are underway that explore the use of seagrasses as carbon sinks. We need to value

the health of our ocean for its ecosystems and creatures, but also because it is likely to play a very significant role in combatting climate change in the future.

Sand carting via trucks from an external source

Option 3.

Sand carting via trucks from either the northern beaches or from an external source should only be used as a last resort.

Sand carting via trucks is currently used an interim measure and is causing a great deal of disruption in terms of trucks on the road and at delivery sites, Trucks increase environmental harm to the atmosphere. Additional trucks are needed for delivery of sand to the beach.

The sand carting option does not provide for a **mass infill** which is what is needed at **West Beach** and **Henley Beach South**. Sand carting will maintain our beaches in their current undernourished state and will not return our beaches to health and equilibrium.

Sand would be delivered to West Beach. This is problematic for Henley Beach South as there is **NO BEACH ACCESS** at Henley Beach South and trucks have to cross the Torrens Outlet in order to deliver sand to Henley Beach South. This is often not possible due to strong water flow or storm activity.

Trucks on the beach at Henley Beach South create an added threat and disturbance to the already highly threatened Hooded Plover, particularly near the Torrens Outlet area.

Pipeline

Option 2.1

This option provides for an initial nourishment at West Beach but does not mention **Henley Beach South** that also requires **an initial mass infill.**

It is apparent that this mass infill would need to come from other sources, either sand carting from quarries, the northern beaches or via a dredge. The difficulties with dredging are discussed above.

This Pipeline option is ready to go and has environmental approval and planning approval. The design has been fully formulated. However, an additional design would need to be developed to extend the pipeline to Largs Bay and beyond.

At this point in time it may be beneficial to extend the pipeline to Section Bank. This assumes that the problem with POMS has been resolved.

A pipeline will provide certainty and a sand source for all beaches. It will provide flexibility and sand can be managed on a needs basis.

It will largely be out of sight as the pipeline is buried.

Sand needs to be recycled. It travels from the south to the north and needs to be returned from the north to the south.

Henley Beach South has suffered greatly over the past years with severe erosion, loss of sand, loss of a healthy beach profile and dune system, loss of a beach during the winter months, loss of facilities and infrastructure.

We seek for our beach to be returned to health and equilibrium and for our local environment to be valued and protected.

We support the Pipeline option.

To conclude

We request that the Panel ensures that:

- all beaches are treated equitably
- there is a whole of coast approach
- the environment is not subjected to unnecessary harm
- a system is recommended that provides certainty, flexibility and longevity
- our coastal system be given the high value that it deserves on a social environmental and economic level
- the environment be given the highest consideration
- a sustainable system be put in place that works with environmental processes
- there is a long term view that will ensure that South Australians in the future will still be able to enjoy our beautiful coastal system
- everything is done to maintain our oceans and all of the diversity within these oceans
- future scientific exploration and discovery is not restricted or prevented by the impact of dredging activities and the environmental harm that such activities could generate
- that future eco businesses are given consideration

Thank you for your time and due diligence. We respectfully request that the IAP give strong consideration to the science and recommend a solution that is based on science, fairness and sustainability, so that we will have a beautiful coastal system long into the future, when many of our current voices will no longer heard.

Yours sincerely

Bernadette Cranwell
Henley Dunes Care Group
[redacted]

From: Kerry Rensonnet
To: mail
Cc: attorneygeneral@sa.gov.au; officeofthedeputypremier@sa.gov.au
Subject: Adelaide Beach Management Review
Date: Saturday, 14 October 2023 11:57:44 AM

Hello there,
My name is Kerry Rensonnet and I have lived in the Semaphore/ Largs area for 18 years. I have walked my dog down the beach every day, except when on holidays, for 14 of those years rain, hail or shine. It is a beautiful area with the beaches, bustling Semaphore and Jetty rd, historical Port Adelaide and a vibrant, friendly community.
The goals of The Adelaide Beach Management Review as stated are :
1. Minimise disruption for all communities
2. Avoid Environmental Harm
3. Maximise sand staying on beaches
so these are what I will focus my submission comments on
Options 1.1 and 1.2 state dredging will be done 2kms offshore, however with Option 1.3 there is no mention of distance from shore.
Providing there are environmental turbidity and sea grass studies undertaken the dredging options seem to best meet the reviews goals in my opinion.
1. Minimising disruption for all communities:
No trucks, sand planes, excavators or noisy pumping stations on any beaches.
No beach, beach access or jetty closures for 4 months of the year on any beaches with no disruption for local communities, visitors, tourists and local businesses.
The lower cost of the dredging options must also be less of a disruption for all communities when compared to the very expensive, inflexible pipeline option.
2. Avoid Environmental Harm:
With this option, no sand is removed from beaches leading to lowering of beach level and leaving the foredunes exposed to severe erosion.
EPA studies will monitor turbidity and effects on sea grass
Flora, fauna and intertidal organisms will not be removed and destroyed as happens when sand is removed to a depth of between 300-1000 mm by a sand plane leading to loss of the dune system
3. Maximise Sand Staying on Beaches:
Dredging would appear to have the most positive outcome for all beach communities along the Metropolitan Coastline
No sand is removed from any beach, consequently leading to foredune damage.
Note: The Digital Earth Australia 2022 data shows Semaphore beach has lost 70m since 1993 and Largs beach has receded by 30m since 2016
DEW have referred to The Northward drift of sand along the coastline being solid reasoning for mining it from Semaphore and Largs but it is clearly not landing on the beach, but possibly deposited off the coastline, which would be another positive outcome for the dredging option.
Pumping the sand offshore at West Beach rather than putting the sand directly onto the beach has worked in places like Denmark, Maroochydore and others where the sand is washed into the shore and builds up rather than being washed away in the first high tide or storm event after being placed on the beach.
Options 2.1 , 2.2 and 2.3 all involving a pipeline
The coarse filtering approach used by Bluecoast to reach the varied options included
" Is it acceptable? " in which the criteria were …" minor adverse impacts with clear approval pathway and broad community support expected "
It is difficult for me to understand how a pipeline fits these criteria.
1. Minimise disruption for all communities:
The initial construction and implementation of the pipeline will close beaches, car parks, bike and walking paths, beach access and community volunteer groups along 13.2 kms of the Metropolitan coastline for an extended period of time.
Trucks, sand planes and excavators will continue to be on the beach for 4 months of the year collecting sand and moving it to pumping stations disrupting all beach activities, creating dangerous, uneven surfaces around the jetties and beach, diminishing beach access. In the past when sand mining has occurred the trucks have had little respect for speed limits and distance from people rules that should be adhered to as a matter of community safety.
The pumping stations which are located very close to Semaphore jetty, The Palais, The Largs Bay Sailing Club

and residential homes are very noisy, disruptive, ugly and again the large area required to be fenced off disrupt beach access, walkers, visitors and the businesses associated along the coastline. These pumping stations it has been stated can run for 12 hours per day for 4 months of the tear.
2. Avoid Environmental Harm:
13.2 kms of digging through dunes and beach along the popular metropolitan coastline destroying native flora and fauna. Causing damage to the dunes which are our only defence against sea level rise and more frequent storm activity which may take years to recover if ever.
Trucks, sand planes and excavators will continue to take massive amounts of sand once a pipeline is completed, lowering the beach, destroying the associated flora and fauna including intertidal organisms. This again leaves the dunes open to erosion and foredune loss.
Massive amounts of micro and nano plastics (I'm unsure if any studies have been undertaken regarding this) from a plastic pipeline filled with an abrasive sand slurry will be pumped onto West Beachand subsequently flow out to sea.
3. Maximise Sand Staying on Beaches:
A pipeline with its associated removal of tens of thousands of cubic metres of sand from the Northern beaches is the polar opposite of this goal.
The sand from the pipeline option being placed on West Beach does not stay on the beach either, sand has been put on West Beach in massive amounts over the last 40 or more years and has not stayed there, it must be time to try something new.
The sand North of Semaphore jetty has been proven many times (including in the DHI report for The DEW) to be too fine for West Beach replenishment and therefore easily washed away with the first storm.
As mentioned before the Digital Earth Australia satellite data 2022 shows that Semaphore and Largs beaches are both losing sand and an inflexible, expensive pipeline removing even more sand with no other option if and when it fails due to catastrophic environmental damage of the Northern beach's would be a disaster.
Option 3. Trucking sand from quarries and beaches:
1. Minimise Disruption for all Communities:
Yet again, removing sand from beaches will see sand planes, trucks and excavators driving along the local, popular tourist beaches of Semaphore and Largs Bay. Speaking to beach goers when walking my dog, many regular walkers come from the Northern suburbs along The Expressway and call Semaphore/ Largs "their local" beach. Interstate and overseas visitors are regularly drawn to the bustling, pristine costal community of Semaphore/ Largs beaches.
Huge sand mining trucks and excavators do not belong on popular, well used metropolitan beaches. Not only do they disrupt beach users with the dangerous, uneven mess they make and leave on the beach which both people and pets have fallen into or tripped over in the past, they deter visitors from coming to this section of coastline for 4 months of the year impacting the many cafes, hotels and businesses associated with the area.
West Beach community, I imagine would also be affected during the times sand is dumped onto the beach and moved around with excavators, denying access and creating dangerous safety hazards.
2. Avoid Environmental Harm:
As mentioned previously with massive sand removal comes removal of beach fauna and intertidal organisms. Lowering of beach leaving the dunes open to erosion and loss of foredune, our main protection for coastal infrastructure.
2 years of sand mining along Semaphore and Largs beaches in 2020 and 2021 resulted in a significant and noticeable loss of the dunes. 12-15m in one year as stated by James Guy (previously with The DEW) There has been no sign of dune recovery or lessening of the scarps that were created to date.
3. Maximise Sand Staying on Beaches:
Digital Earth Australia 2022 data shows both Semaphore and Largs beaches have receded over the last 30 and 7 years respectively.
Removing sand which is unsuitable for West Beach anyway is a direct contradiction of this goal.

Placing sand on West Beach for the last 40 years or more hasn't worked for West Beach either. The sand does not stay, surely it's time to try an alternative?
Conclusion:
Throughout this whole process of review no mention of climate change has been made.
With increasing storm frequency and severity and rising sea levels the dunes are essential for coastal protection.
The data used by Bluecoast was out of date.
Surely removal of any sand from any beach is a recipe for disaster in so many ways.
Thank you for taking the time to read my submission.
Sincerely Kerry Rensonnet

From: Deb Walker
To: mail
Subject: Submission, Adelaide Beach Management Review
Date: Saturday, 14 October 2023 5:04:39 PM

To URPS
I have lived in Semaphore for the past 25 years. I am an active member of the Semaphore and Largs Dune Group, and Save Our Shores. I represented Semaphore residents in the first community consultation on the sand pipeline 3 years ago (under the Marshall government) and I represented Save Our Shores at the recent stakeholders workshop at West Lakes on September 27th this year, soon after the announcement of the final 3 options of the Adelaide Beach management review.

I have completed the YourSAy survey and included my thoughts and priorities regarding these option based on information made public by DEW, namely 'Have your say on the future of Adelaide's beaches Future management options'.
I have read pages 1 - 101 of the draft of the shortlisted options presented to the Adelaide Beach Management Review Independent Advisory Panel as well as community stakeholders by Bluecoast Consulting Engineers. While I appreciate this document is preliminary in nature and subject to change, this submission includes further thoughts and queries about information on the options presented in both documents, particularly regarding their compatibility with the 3 goals of the review.

: In my view, there seems to be only one beach community for whom the 3 goals of the review are met with every option. If options 2 or 3 are chosen, none of the goals will be met for the northern beaches, especially Semaphore and Largs Bay. The amount of sand on these beaches will not be maximised. The communities who use them will suffer severe disruption, and there will be considerable environmental harm.

: The rational for carting and the pipeline is based on the premise that there is excess, suitable sand at Semaphore and Largs Bay. This premise seems illogical given the satellite data (2022 DEA CSIRO satellite imagery) which shows that over the past 30 years 70 metres of sand has been lost from Semaphore beach, and 30 metres from Largs Bay. In addition, sand grain size at Largs Bay has already been deemed to be too small to remain at West Beach once deposited there.

: Did Bluecoast Engineering not find this readily available above mentioned CSIRO data in their methods to determine all options? Methods including "reviewing available literature, data and precedent projects" (p77 paragraph 2, draft document)?

: I raised the following concern at the stakeholders meeting but I was dissatisfied with the answer. My concern relates to option 1.3 of the DEW document. The distance from the shore to the dredging site is not stated (as it is for 1.1 and 1.2, ie approx 2 ks). I raised the possibility that the dredge might be very close to shore. Evan Watterson, spokesperson for Bluescope Engineering replied that the distance of the dredge to the shore in this option is 'likely to be' the same as that stated in 1.1 and 1.2, and that in any case the trailer suction hopper dredge cannot operate in shallow water. No distance was given, and he did not define 'shallow'. I was not instilled with confidence with this answer.

: Each of the options will have an environmental impact. In the absence of environmental impact studies (EIS) on each of the options, it seems that dredging will have the least impact.
Questions. Since community responses in HaveyourSAy are really just based on guesswork, how much importance will the community responses be given in determining the final option?
If an EIS finds the dredging option is too harmful to proceed, what will be the fallback?
Will the community be invited to respond again?

: I have concerns about the absence of strategies to retain sand on the beach once it has been deposited at West Beach. A significant amount of sand deposited in recent years disappears out into the gulf in the event of storms and king tides. Inappropriate sand grain size (contained at Largs Bay) will exacerbate this loss. Carting and the pipeline will see this loss continue ad infinitum.

: Climate Change and associated sea level rise and increasing prevalence of storm events will only increase the volume of sand lost at West Beach and indeed, all our beaches. Under these circumstances, taking sand from one beach to replenish another seems to be a folly.

: Sand from the Murray mouth has already been dredged. Sand grain size at this site has been deemed to be appropriate. Appropriation of this sand will cause negligible loss of wildlife habit or destruction of dune vegetation or sea grasses. It will not introduce micro or nano particle plastics onto the dump site. Sourcing sand from here would not disrupt beach communities or detract from tourism.
This option was funnelled out in the review process as being too costly. A figure was not given, but what cost the perfect site? A pity. Could this option be revisited?

: As of October 13th, the Port Adelaide Enfield council announced that it does not support options 2 or 3, and that it supports the dredging option on condition that a technical investigation into environmental and noise impacts is carried out. I whole heartedly supply my council's stance.

Semaphore beach is my place but I care for all our metropolitan beaches. They are all iconic and need care and careful planning so we can enjoy them into the future. Over the past century there have been too many mistakes made; some out of ignorance and mismanagement, some from self interest, some from expediency and politicking. I welcome this review and am hopeful that the best option will be chosen without fear or favour.
I would like to publicly speak to this written submission at a meeting of the Independent Advisory Panel.

Sincerely
Deb Walker

Sent from my iPad

ADELAIDE COASTAL COMMUNITY ALLIANCE

Adelaide Beach Management Review
Options Shortlist Submission

Adelaide Coastal Communities Alliance
October, 2023

Adelaide Beach Management Review Options Shortlist – Adelaide Coastal Communities Alliance

Introduction

Adelaide Coastal Communities Alliance (ACCA) founded in 2021, brings together eleven previously established environmental, business and residents' groups from along the Adelaide coast. ACCA has been researching and sharing information about current international best practise in sand management. During 2022 and 2023, ACCA held a series of intensive workshops, examining a range of possible sand management options for use on the Adelaide beaches. These workshops high-graded possible solutions that comply with the government's goals of maximising sand staying on beaches, avoiding environmental harm and minimising disruption to communities, while taking into account potential climate change impacts along our Adelaide coastline. ACCA recognises the critical importance of consultation with South Australia's First Nations' People.

ACCA's research has highlighted the urgent requirement for access to additional external sand resources to be the primary requisite for future beach management strategies as a defence against continuing erosion caused by rising sea levels and increased storm frequency. Median shoreline projections show by mid-century, sandy shorelines will retreat by between 50 - 80 metres in Australasia (Vousdoukas et al, 2020) noted in the IPCC Sixth Assessment Report 2021. If nothing is done or the wrong management strategy is applied, this will result in the disappearance of most of our metropolitan beaches. Short (2022) notes rising sea levels will trigger this shoreline retreat, but beach systems can be more resilient to sea level rise if they have a balanced to positive sediment budget. It is well known from the early work of Bowman & Harvey (1986) that the metropolitan coast has been naturally running out of sand with dwindling southerly input of less than 10,000 cubic metres per year (which feeds only the Kingston Park to Glenelg sector) into a coastal system with much larger longshore drift rates of over 100,000 cubic metres per year.

Large volumes of additional external sand are required to be continually injected into the Adelaide Beach system – two options provide that essential requirement, the dredge barge variants and the trucking of quarry sand. ACCA considers the only truly flexible, sustainable and economical option in the long term is the dredge barge because with increasing sea levels, there will be a continuing increasing demand for nourishment sand and land based resources will become cost prohibitive. "Soft engineering" strategies, like stabilising sand movement need to be considered which allows seagrass to regenerate naturally or oyster beds to help diffuse wave energy, to protect the beaches from erosion. We might want to assist nature in this process.

Recycling of the same sand from beaches just transfers the erosion hotspot from recipient to donor and pipeline systems deliver borrow sand as only an ineffective, temporary, cosmetic fix directly onto the beach which is shown to be quickly eroded. There is also significant microplastic pollution associated with an abrading plastic pipeline, all of which will be of micro and nano sized particles washed with the sand slurry into the marine food chain. This significant pollutant enters the marine food chain and cannot be ignored.

Options 1.1, 1.2, 1.3 Dredge Barge Variants

STRONGLY SUPPORT

Strengths: Most Flexible, Least Disruptive to Beach Amenity and Communities, Most Effective for Keeping Sand on Beaches, Most Economic Strategy.

Major Proviso: In recent years, tighter control of dredging in the form of strict regulations, enforcement and monitoring, and mitigating measures together with proper impact assessment and development of new environmental dredging techniques has helped to prevent or minimize adverse impacts on seagrasses.

ACCA's preferred option, outlined below, has a well-documented, worldwide record of effectiveness in providing coastal protection. Not only has a mini sand engine been recommended and modelled for the Adelaide coastline by DHI in 2018, a similar large-scale sand replenishment or "mass-nourishment" project has been well-documented for over 10 years in the Netherlands (Stive et al, 2013), with long-term beneficial results. The delivery of sand, from an external source, via barge to be placed as mass fill, close to the nearshore at West Beach, has a high degree of engineering feasibility. Modelling for a mass-nourishment of 1,500,000m^3 has already been completed, with an expectation to be effective for 7.5 to 10 years. ACCA's preferred option would remove trucks and heavy machinery from all metropolitan beaches and require no fixed coastal infrastructure and can be managed with a very light environmental footprint. Other secondary, soft engineering options, such as dune restoration, seagrass regeneration and oyster reefs can be incorporated into this approach where appropriate.

Barging would entirely eliminate the need to have trucks on the beach. A dredge-barge option would also give coastal managers the ability to modulate dredging and discharge, to match the rate of erosion or accretion at individual beaches. It would have the added flexibility of being able to move sand from anywhere along the Adelaide metropolitan coast or, in fact, anywhere in the State, or indeed, anywhere in Australia where sand is needed or not needed, as the case may be.

The use of offshore dredges and/or dredge-barges, to utilise offshore sand resources, is a system that is being adopted elsewhere in Australia and around the world, is economically feasible and has multiple additional social and economic benefits. Further investigation is required into the use of previously assessed reserves of suitably-sized offshore sand deposits, from South Australian waters. The comprehensive cost of an offshore dredging program is economical and has the added

benefit of mass replenishment of external, coarser grained sand, which helps to slow the rate of erosion and protect community assets in the process. Flexible offshore dredging and nearshore mass-replenishment by dredge-barge slows the rate of erosion over time without the need to install hard structures, or the use of trucks and excavation machinery on beaches. Flexible offshore dredging and nearshore mass-replenishment by dredge-barge has minimal impact on beach amenity and communities. Offshore dredging and nearshore mass-replenishment by dredge-barge is by far the most economic and effective strategy.

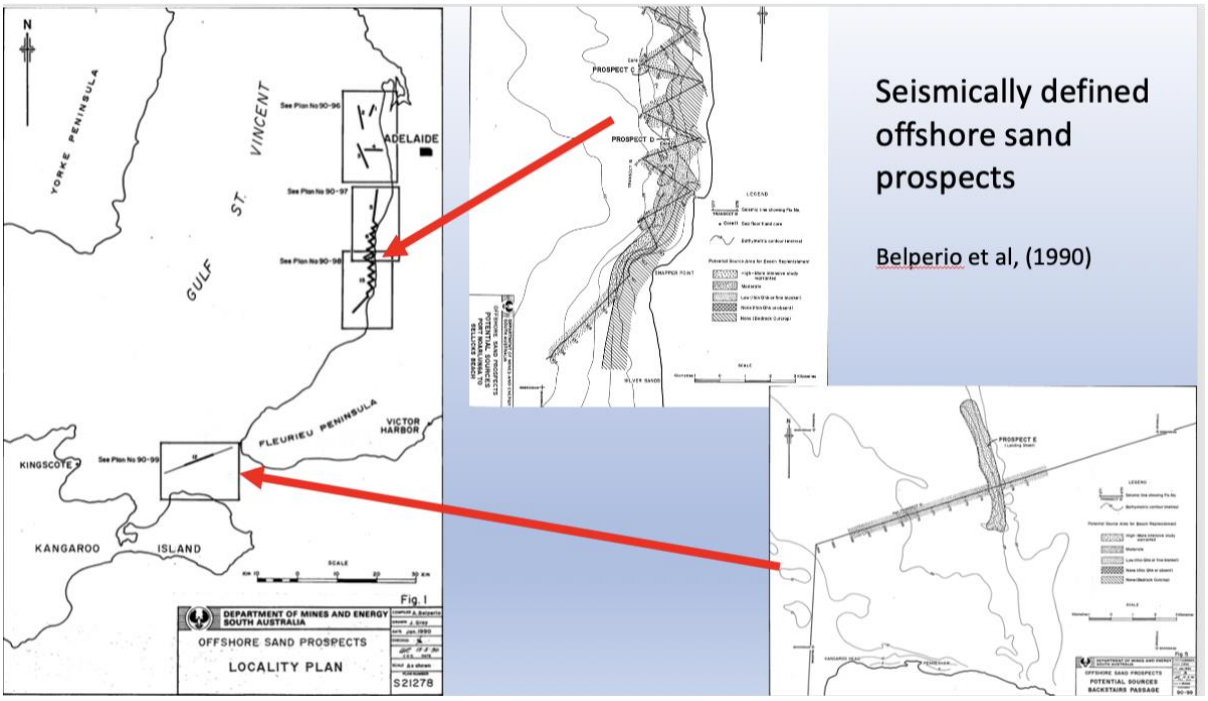
The building of a mini sand engine was modelled for West Beach and recommended by DHI in 2018. Having larger amounts of external sand placed in the near shore zone will result in building the beach and coastal dunes further west, away from infrastructure. This would also assist in managing the impact of sea level rise, by building up the beach and dunes, rather than retreat and defend, using rock wall revetments, which now appears to be a losing strategy.

The proposal for external sand to be barged to West Beach and deposited in the nearshore zone, aligns with the key objectives contained in the South Australian Government Climate Change Action Plan 2021-2025. The SA Government must prioritise future funding to create a resilient coastline, to protect public infrastructure, the unique coastal and marine ecology, public amenity, tourism and the business economy.

Sand recycling is a tenuous way to balance the sand budget because there is not enough sand to go around. Providing an external source of sand with a flexible approach would put an end to sand wars that have been so divisive in the community. This government with the right approach could be the government that reunites all coastal communities, while achieving a key outcome of the Climate Change Action Plan 2021-2025.

Where is the sand going to come from?

There are several offshore sand deposits that are not, at present, connected to the beach system, which have been identified and assessed by the Government (Belperio, et. al., 1990) and could be economically dredged and transported, to maintain Adelaide's metropolitan beaches, with minimal social and environmental costs. This does not include Section Bank, which has been specifically ruled out. Smaller deposits of suitably sized sand at Port Stanvac and offshore deposits identified further south, along the Fleurieu Peninsula could, subject to an appropriate Environmental Impact Assessment process, be selectively dredged.



There is also a large accumulation of sand in the Coorong, immediately adjacent to the mouth of the Murray River. This accumulation of sediment in the flood-tidal delta threatens to close the mouth of the Murray and restrict circulation in the Coorong which is a RAMSAR wetland of international significance. The Commonwealth invests around $10 million per annum to dredge approximately 850,000m^3 of sand, placing half onto the Sir Richard Peninsula and half onto the Younghusband Peninsula, only to return again, when the flood-tide backflushes the mouth, taking entrained beach sand with it. The Wentworth Group of Concerned Scientists (Thom, et al., 2020) has pointed to the futility of the existing dredging program, which has been temporarily halted due to the Murray River being in flood. It is understood that, without sufficient freshwater inflows, the dredging program would be required approximately 95% of the time.

Re-circulating sand from the beach to the flood-tidal delta at the Murray mouth is an expensive and ineffectual exercise that is providing a poor value return on public investment. However, a novel solution would be to transport approximately half

of the annual accretion in the flood-tidal delta by dredge-barge for mass nourishment at West Beach, to assist in solving the Adelaide's coastal erosion problems. Placing the remainder of the dredged sand onto the Sir Richard Peninsula would have the effect of moving the mouth of the Murray River slightly to the South-East and, in the process, improve the circulation and navigability of the Coorong. Local Ngarrindjeri people would be consulted, to ensure substantial social and economic benefits emanate from the proposed dredge-barge program.

Utilising the offshore sand deposits from Gulf St Vincent, in the short to medium term, would assist in fine-tuning some of the operational requirements associated with, what is potentially, a much larger and longer-term, dredge-barge program at the Murray mouth. It would also help train the workforce that would be required, once all of the Traditional Owner and Commonwealth Government environmental approvals are in place.

Option 2.1, 2.2, 2.3 Sand Pipeline variants

STRONGLY DO NOT SUPPORT

Weaknesses: Costly infrastructure required to access a marginal resource, Inflexible to adapt to rising sea levels, Has large impact on northern coastal communities, Nourishment onto the beach already shown to fail international durability metrics, Produces unacceptable, large volumes of abraded nano plastics and microplastics to the marine environment over its life time, Very expensive capital investment, marginal to no benefit strategy.

ACCA has serious concerns on the economic and technical viability of the proposed northern sand pipeline and its consequential effect on coastal resilience and the amenity of northern beaches. The economic, social and environmental cost of extracting sand from popular northern beaches, where the sand is finer and becoming finer still, outweighs any benefits to receptive beaches. An increase in supplementary sand due to sea level rise, back-end maintenance costs and decommissioning costs, need to be taken into consideration. There also appears to be insufficient concern about the significant microplastic pollution associated with an abrading plastic pipeline, all of which will be of micro and nano sized particles washed with the sand slurry into the marine food chain. Half the 34 -38 mm thickness of the HDPE pipeline is abraded by the sand over the 20 year life of the pipeline – which over 14 kms of pipeline will produce 121 tonnes of micro and nano sized plastic particles.

The Semaphore Park breakwater was never intended as a mine for the central and southern beaches and it cannot be used for that purpose sustainably because the sand budget either side is only in equilibrium when the salient is full and it only yields between 22,000m^3 and 40,000m^3 when it is full. Expecting the Semaphore Park breakwater to yield 50,000m^3 or 100,000m^3 per annum risks the failure of that structure to achieve the purpose for which it was intended. Sand from north of Semaphore Park is not suitable because it is too fine with too much calcium carbonate and would just erode from the beach face at West Beach. As the sand on the northern beaches is finer and more calcareous than the sand at West Beach, it will dissipate around 1.5 times faster. This means that 1.5 times as much sand is needed at West Beach (i.e., overfill ratio). This means approximately 1.5 times the originally estimated sand budget will be required, with a corresponding cost increase.

The northern back-passing pipeline proposal represents environmental damage, social anxiety, escalating economic costs, decreased open space amenity, microplastics in the environment, as well as the possibility of a stranded asset at end-of-lifecycle. We have already seen how in the 2020/21 financial year, over 200,000m^3 of coarse quarry sand and 42,000 cubic metres of northern beaches sand, delivered onto the beach face at West Beach, has eroded swiftly and represents an extremely poor return for the tax payer dollars invested so far. A back-passing pipeline, delivering finer grained carbonate sand from northern beaches, would be even more ineffective. The proposed northern back-passing pipeline would increase the rate of erosion and that situation is only going to worsen with sea level rise and would perpetuate the use of heavy machinery on beaches, which is something that ACCA is firmly opposed to. Lowering the metropolitan beaches, through sand mining, leaves our frontline defences, the sand dunes, at serious risk of erosion, which in turn leaves SA's economy at risk of losing valuable infrastructure, tourist and business dollars, unique biodiversity and a blue space, well-being asset.

Around Australia, beach excavation is being abandoned as a beach management strategy due to diminished public amenity and a worsening situation due to sea level rise. The shift in approach is exemplified at Coogee and C Y O'Connor beaches in Western Australia, where beach sand excavation and truck/pipe transport have been replaced by offshore dredging. While the City of Cockburn previously used a smaller system of beach excavation, sand collection and transport similar to the Glenelg-Kingston Park pipeline up until 2020, it is now dredging offshore sand, to reduce the economic cost and minimise beach closures.

The false dichotomy of trucks versus pipes, does not reflect the fact that, given the choice, the community would prefer to have neither of those systems operating at the coast. Massive earthmoving equipment on our recreational beaches is exactly what would be perpetuated if the proposed northern pipeline strategy were adopted. Sections of the beach at Glenelg are closed to the public for 4-6 months per year during excavation and that situation is expected to continue for another 13 years. The community is now forced to endure the inconvenience and try to ameliorate the social and economic impost. However, there are certain voices in the community who claim that the southern pipeline system is a success, while ignoring the rising operational and maintenance costs, the social and economic impost and the cost to the environment and no-one seems to care about approximately 100 cubic metres of microplastic that will be produced over the lifespan of the southern pipeline.

Option 3: Trucking sand from beaches and quarries

DO NOT SUPPORT

Weaknesses: ACCA strongly does not support any mining and trucking of sand from beaches. Trucking of quarry sand as temporary supplement to other strategies is supported if necessary.

Two completely different scenarios here lumped into the same category – poorly designed question.

Do you have any other feedback?

ACCA believes that every one of Adelaide's metropolitan beaches is too valuable to lose. In terms of economic, environmental, social, physical and psychological well-being, they are invaluable assets to Adelaide and South Australia. There is not enough suitable sand to go around. With sea level rise there will be even less. Climate change impacts, such as more frequent storms and higher tides, are a significant factor and we need a vision for Adelaide's metropolitan beaches that is more than mere "shifting of the deck chairs...". The government should be prioritising a more resilient coastline because Adelaide's beaches and their dune systems are the frontline defence against the impacts of climate change. The division caused by pitting Adelaide's coastal communities against each other needs to stop and this can be achieved with the right solution.

The community has had to endure the public risk and altered amenity, resulting from having excavation machinery, trucks, trommels and pump stations operating on recreational beaches. The proposed pipeline strategy would continue to perpetuate the use of trucks and excavators on the beach. The diminished amenity associated with the visual impact and noise pollution, caused by the operation of the pipeline itself, has a significant impact of the quality of our blue space well-being assets. The immediate environmental impacts associated with the construction of the pipeline, as well as chronic impacts, like increased delivery of microplastics into the environment, will do irreparable damage to the beach and dune environment and the unique coastal and marine ecosystems they support.

The proposed northern back-passing pipeline strategy reflects outdated thinking and outmoded technologies. It cannot be used as a one-stop-shop approach because more sand will be needed at West Beach than can be supplied by the proposed northern pipeline. Working against nature increases the rate of erosion and increases the rate of expenditure from the public purse which will only increase over time. Other jurisdictions are moving away from fixed pipelines and adopting more flexible offshore dredging and nearshore replenishment to improve the economics and amenity impact of beach replenishment programs.

Mass replenishment by barge is more efficient than drip-feeding, end-of-pipe solutions. Nearshore deposition is more effective than onshore deposition because it buffers the beach – nearshore sand will wash up on the beach and stay on the beach longer rather than slide down the slippery slope and be washed away.

It is time to prioritise funding to develop a holistic and strategic defence against the impacts of climate change on our coastline. By building a resilient coastline we will be protecting the invaluable aspects of SA's economy.

References

Belperio, A. P., Harvey, N. & Rice, R. (1990) *Offshore Sand Prospects for Metropolitan Beach Replenishment Interpreted from Shallow Seismic Profiles*. Department obf Mines and Energy, South Australia, Report Book No 90/13.

Bowman, G.M.; Harvey, N. (1986) *Geomorphic evolution of a Holocene beach-ridge complex, LeFevre Peninsula, South Australia.* Journal of Coastal Research. 1986; 2(3):345-362.

Carley, J.T. & Mariani, A. (2007) *Technical review of the Semaphore Park trial breakwater, South Australia.* UNSW Water Research Laboratory Technical Report No. 2007/14. https://doi.org/10.4225/53/58e1b831d4b69 accessed 21/05/2023.

Culver, R. (1970) *Final summary report on beach erosion studies*. University of Adelaide, Department of Civil Engineering. Report commissioned by the Seaside Councils Committee and the State Government of South Australia.

DHI (2018) *West Beach Coastal Processes Modelling Assessment of Coastal Management Options.* Final Report to DEWNR, prepared by the Danish Hydraulics Institute.

Short, A.D. (2022) *Australian beach systems: Are they at risk to climate change?* Ocean and Coastal Management 224, 106-180.

Stive, M.J.F., de Schipper, M.A., Luijendijk, A.P., Aarninkhof, S.G.J., van Gelder-Maas, C., van Thiel de Vries, J.S.M., de Vries, S., Henriquez, M., Marx, S., & Ranasinghe, R. (2013) A New Alternative to Saving Our Beaches from Sea Level Rise: The Sand Engine Source. *Journal of Coastal Research*, 29(5): 1001-1008. https://doi.org/10.2112/JCOASTRES-D-13-00070.1 accessed 21/05/2023.

Thom, B., Rocheta, E., Steinfeld, C., Harvey, N., Pittock, J. & Cowell, P. (2020) *The role of coastal processes in the management of the mouth of the River Murray, Australia: present and future challenges.* River Research and Applications 36, 656–667. SPECIAL ISSUE PAPER, Wiley, https://doi.org/10.1002/rra.3551 accessed 21/05/2023.


ADELAIDE
COASTAL
COMMUNITIES
ALLIANCE

WESTERN ADELAIDE COASTAL RESIDENTS' ASSOCIATION

SUBMISSION TO THE INDEPENDENT ADVISORY PANEL

Re

ADELAIDE BEACH MANAGEMENT REVIEW DRAFT SHORT LIST

15 October 2023

The Western Adelaide Coastal Residents' Association (WACRA) appreciates the opportunity to make this submission to the Independent Advisory Panel (IAP) on the draft short list presented by Bluecoast Consulting Engineers (Bluecoast) to the stakeholder workshop on 27 September 2023.

Executive Summary

WACRA is profoundly disappointed in the information presented by Bluecoast and considers that it fails to meet the objectives of the Adelaide Beach Management Review (ABMR) or the expectations of the community. WACRA considers that significantly more scientific analysis is required of all of the original longlist options before arriving at recommended options.

If the Government refuses to commission that further scientific analysis, Bluecoast should, at least, be required to provide scientific support for each of the seven options it has put forward in the draft short list and to answer specific questions relating to each of them. Without this input, it is impossible for the community to offer informed comment on the options.

Subject to being provided with that analysis, and having the specific questions fully answered, WACRA offers its conditional support for Option 1.2 Dredge Using Large Offshore Sand Deposits.

Given the mass filling required for West Beach and the need to retain as much sand as possible from the effects of storms and tidal drift, consideration should be given to modelling or trialling off-shore geotextile groynes.

Failure of Process

On 9 June 2023, WACRA responded to the invitation to lodge a submission to the ABMR after publication of the long list of options and having attended the first community workshop on 15 May 2023. Our comments included:

- The Review must identify the combination of approaches that will deliver the best solution and not be constrained by the financial capacity of the Government to deliver each approach. (The terms of reference of the Review make no mention of costing or budgeting but Bluecoast inserted it as part of its coarse filtering process and has provided projected 20-year cost estimates for each option. We challenged that aspect at the time and still consider it inappropriate to identifying the objectively best outcome.)

- Bluecoast must provide detailed reasons justifying the discarding of each approach in the long list, by reference to the coarse filtering approach criteria. It will not be sufficient for there to be a mere statement that a particular option was considered not effective, or not practical or not acceptable. Detailed reasons for any such conclusion must be provided.
- The West Beach boat harbour is the root cause of many of the problems being addressed by the ABMR and its potential removal should be seriously considered, including comparing the loss of amenity to a relatively small group of boat owners with the potential benefit to the environment, marine life, fauna and flora, and a vastly larger segment of the population, along with a detailed cost analysis comparing the potentially significant but one-off cost of removing the boat harbour with the large and ever-expanding cost of managing the sand replenishment which its continuing existence will require in perpetuity.
- A request for an explanation of how the role of the Kaurna representatives on the IAP, including consultation with the wider First Nations Peoples community affected by the Review and engagement with them in the processes of the Review, is being undertaken.
- Our view that climate change (and, in particular, sea level rise and the increased frequency and intensity of storm events) should be a paramount consideration in the assessment of sand management approaches. At the very least, the Review should adopt as its working assumption, the mid-range estimates of climate-induced changes when assessing the impacts of each option.
- Our view that the effectiveness of particular approaches should be tested by scientific modelling, including tank testing.

We received no reply to our submission and there is no evidence in the information published by Bluecoast that any of those suggestions have been considered.

The "scientific review" to be undertaken by Bluecoast as part of the ABMR was required to include consideration of:

1. How to manage sand on Adelaide's beaches to achieve the following goals:
    1. Minimise disruption for all communities
    2. Avoid environmental harm; and
    3. Maximise sand staying on beaches.
2. The Adelaide community's views on sand management options and on the impact of the current sand management approaches including trucking and pipelines.
3. Lessons from international examples of sand management on metropolitan beaches.
4. What can be learned from the most up to date analysis of climate science about future management of Adelaide's beaches. (see www.environment.sa.gov.au/topics/coasts/adelaide-beach-management-review)

The information published by the Department for Environment and Water (DEW) to date includes the seven options outlined in the discussion paper published at Adelaide Beach Management Review Options Shortlist | YourSAy, the cover note of 20 September 2023 from Bluecoast to the IAP and a brief half page description on DEW's website of "Why weren't some options shortlisted?" None of those documents contain reference to any science. The cover note provides "draft technical information", but this merely relates to engineering matters, not scientific analysis. There is no reference to lessons from international sand management or analysis of climate science.

If Bluecoast has conducted the scientific analysis as required by its terms of reference, this should be published immediately. Without that information, the community will have no more confidence in the outcome of the ABMR than it had in the former Government's proposal to build the pipeline.

The AMBR was intended to remedy the fundamental flaw in the previous Government's approach by basing the identification of the best solution to the problem on an independent, objective, scientific analysis. In this way, there would be confidence that the preferred solution would deliver the best possible outcome according to scientific analysis of the best available data, unaffected by political or emotional vested interests.

Furthermore, while implementing the outcomes of the ABMR is a State Government role, responsibility for maintaining the amenity of our coast falls to the coastal Local Governments – specifically, the Councils of the City of Port Adelaide Enfield, the City of Charles Sturt and the City of West Torrens. These have significant resources, expertise and experience in coastal management yet have not been engaged in the review process in a collaborative process, or in any meaningful way other than providing submissions such as this one.

As the matter currently stands, the community is being asked to support or oppose options that are apparently unsupported by scientific analysis. Predictably, community groups and local governments up and down the coast are reverting to their respective well-rehearsed self-interests to advocate for different options. The opportunity for the ABMR to overcome those self-interests has not, yet, been achieved.

Short List to Long List

The long list of options was comprehensive and represented considered input from many well-credentialed experts and well-informed residents along the coast. Bluecoast adopted a "coarse filtering" approach which, in summary, asked whether each option was effective and/or practical and/or acceptable. We are concerned that the process seems to strive for a one-fix, magic bullet solution. In reality, a combination of approaches is more likely to be successful and any implementation must be carefully monitored, assessed and continuously evaluated.

WACRA's submission of 9 June 2023 requested that Bluecoast provide detailed reasons justifying the discarding of each approach in the long list. This recognised that each of the long list options had different claims to effectiveness, practicality and acceptability but expected that a *scientific* analysis of each would determine how it ranked.

The web page "Why weren't some options shortlisted?" does not even come close to achieving this. It claims that "the assessment of the long list of options used an evidence-based approach drawing on information and data from previous coastal monitoring, studies and research on Adelaide's beaches, and the impacts of climate change …" but there is no published information proving that process was undertaken. There is merely a list of the options that "were not shortlisted for further analysis." The validity of those decisions must be proven by publishing the bases on which they were made.

Some examples illustrate the shortcoming:

- Where is the analysis of the pros and cons of removing West Beach boat harbour, including the aspects referenced by WACRA in our 9 June 2023 submission? When challenged on this at the 27 September 2023 workshop, Bluecoast's representative simply said removing the boat harbour "could not be done".

- The progressive destruction of the seagrass beds has had an adverse effect on the condition of the beaches. Small scale efforts to re-establish them are underway. Where is the scientific analysis of the benefits or otherwise of their large-scale re-introduction?
- Retaining any sand delivered to West Beach (and others) on the beach is of paramount importance and specifically mentioned in 1.3 of Bluecoast's terms of reference. Temporary (sand-filled geotextile bag) groynes were one long list option – one supported by considerable analysis by the proponent. Where is Bluecoast's scientific analysis of this option? When challenged on this aspect, Bluecoast's representative claimed that groynes are unacceptable because they prevent people walking on the beach and are unsightly. Hard (rock or concrete) groynes perpendicular to the beach may be, although they may also be effective to retain the sand. But the proposal for temporary groynes, of different lengths and heights and placed at different angles to the beach may not offend in the same way and, being temporary, may be acceptable if they achieve the desired retention of sand and re-form the beach. (Such groynes deployed between Glenelg and Kingston Park beaches have been successful.) Without proper assessment, perhaps including the tank test modelling advocated by WACRA, the viability of this option cannot be known.

At the 27 September 2023 workshop, Bluecoast's representative presented a slide showing "Table 12: Summary of coarse filter results". It showed a "Stop" rating for fixed bypassing systems, removal of existing harbour structures, groynes and reduction of wave climate. No evidence was presented as to why these options rated a "Stop" rating but it suggests that no analysis of the types notted in the bullet points above was undertaken. Bluecoast's representative seemed to confirm that, if an option scored a "Stop" rating against any one of the criteria (effective, practical or acceptable), it was excluded from further consideration. This approach would prevent such an option being included in an effective suite of options to obtain the best outcome. The filtering process does indeed seem to be "coarse" and seems to pre-emptively preclude the possibility of any of these options contributing to the solution.

Short List

WACRA considers that the process for deriving the short list was flawed and that the expected scientific analysis of each of the long list options should be undertaken.

Should the Government refuse to commission that analysis, however, WACRA considers that Bluecoast must provide, at least, a proper scientific analysis of the short list options. In the absence of such an analysis, the community simply cannot provide an informed assessment of the options. Many of the options contain unassessed assumptions and some propose actions that have previously been expressly declared non-viable by DEW in the reports Bluecoast purports to have reviewed. These include, but are not limited to:

Dredging

During the Community Reference Group discussions relating to the former pipeline project, DEW repeatedly advised that dredging was not an option, though without detailed explanation. Historical dredging has caused terrible damage through turbidity and other effects in Gulf St Vincent but more recent dredging of Outer Harbour was completed without such damage through the implementation of strict environmental controls.

- Where is Bluecoast's analysis of the expected impacts of proposed dredging on marine life (fish stocks, sub-floor fauna, seagrass etc) and turbidity and the effect of the re-shaped sea floor on the adjacent beaches?

- What are the prospects of obtaining environmental approvals for the dredging?
- What are the probabilities and practicalities of hiring appropriate dredges?

Land-based Quarries

- Sand from these quarries is not an infinite resource. Has Bluecoast confirmed the ongoing availability of the required volumes?

20-Year Cost

- Why was a 20-year period chosen?
- What is the projected life of each option and what is planned for its end-of-life?

Option 1.1 – Near-shore dredging

- What will be the effect on Bird Island and Section Bank?

Option 1.2 – Off-shore dredging

- DEW has repeatedly advised that the remaining sand at Port Stanvac is contaminated and therefore unsuitable and that it is interspersed with clay which makes retrieval impractical. If this is correct, why is it in Bluecoast's option? Does Bluecoast have information that contradicts DEW?
- Has Bluecoast confirmed that there are adequate supplies of sand offshore Largs Bay and Outer Harbour?

Option 1.3 – Off-shore dredging and quarry sand

- Port Stanvac – see above questions

Option 2.1 – Pipeline and trucks on beaches

- This option is apparently the halted pipeline option proposed by the former Government. It was the unacceptability of this option to the community that gave rise to the ABMR. Bluecoast's representative suggested that it was included because it had already been proposed and DA approved. Has Bluecoast addressed all of the objections to the former pipeline proposal, particularly the environmental damage to the dunes which will be caused by the construction? The design is not exactly as previously proposed. The original pipeline was to commence at Semaphore - what are the consequences of moving the start point North to Largs Bay? What are the practicalities of connecting the proposed pipeline to the existing but non-operational pipeline from the Torrens Outlet to West Beach?

Option 2.2 – Pipeline and jetty dredge pumps

- Has Bluecoast assessed the structural strength of the jetties to accommodate the dredge pump?
- Has Bluecoast quantified the impact of closing the jetties for 3-4 months?

Option 2.3 – Pipeline with temporary near-shore dredge

- What is the proposed impact on the beaches adjacent to the sand intake points?

Option 3 – Beach sand carting

- What are the environmental impacts of this Business As Usual option?

Conditional Support

Because of the lack of scientific analysis and evidence, WACRA is not able to provide unconditional support for any of the short list options. However, subject to obtaining the additional information and assurances requested above, WACRA would give conditional support to Option 1.2 (Off-shore dredging) because:

- It leaves the dunes along the coast untouched – no destruction caused by the pipeline construction
- It removes the environmental damage and safety risks associated with collecting sand on beaches and trucking it to destinations
- It avoids the adverse effects of dredging from jetties
- It minimises the impact on the enjoyment of beachgoers
- It is flexible as to where the sand is deposited, making it possible to replenish not just West Beach but others as required
- It avoids depleting a finite resource in quarry sand, along with the environmental damage caused by trucking it to the coast
- It is relatively climate change proof – it avoids the inevitable consequences of sea level rise on hard infrastructure such as a pipeline
- It avoids the environmental contamination of microplastics which will inevitably result from a pipeline
- It enables the inclusion of measures trialled to maximise sand staying on beaches such as geotextile parallel groynes.

Clearly, any proposed dredging must be done to best environmental practice. It is likely that it would be contracted to one of the major international dredging operators, all of whom are equipped for, and experienced with, working to high environmental objectives. That is now standard practice overseas.

Environmental protection for seagrasses must include having all actual dredging done within silt screens of appropriate grade, based on testing samples from the likely dredge grounds. In the 1980s, port works at Port Pirie were done within silt screens, and were, for the most part, successful in keeping the badly contaminated fines from being remobilised.

The works must be carried out under rigorous, independent, monitoring. Previous dredging for sand was at one time supposedly monitored by 'work experience' personnel, with no experience and little practical authority. The monitors should be able to carry out underwater inspection, at times of their choosing.

– – – – –

In conclusion, WACRA is disappointed with the failure of the process to address its stated purpose or fulfil its terms of reference. We expect to provide a verbal submission to the IAP and look forward to the publication of the Bluecoast report due to go the IAP later this year.

From: Bill Lucas
To: mail
Subject: Beach Management
Date: Saturday, 14 October 2023 11:03:38 PM

I feel there is a need for a beach replenishment program. However, to reduce the movement of sand from the replenished beaches back to the northern beaches why not use groins/breakwaters to hold up and slow down the drifting sand?

I couldn't find in your consultants report any reference to the effectiveness of groins!

Groins have been used successfully all around the world, ie the Devon and Cornish coasts, and in Port Phillip Bay and even closer to home, Beachport in the STH East of SA.

We only need to look at the impact the Nth Haven breakwater has had on the Taperoo beach over the past 40-50 years since its construction! And even the Outer Harbour breakwater! Without the interference of these structures Pelican Point in the Port River would be a kilometre or two further north, resulting in the Lefevre Peninsula being longer than it presently is!!!

Short length groins, ie a kilometre apart, protruding into the sea would allow for any retained sand to be spread back over those sections of nearby beach that have been eroded! A footpath on top of each groin might even be popular for recreational fishers!!!

Why haven't groins been considered as part of the coastal management strategy?

Keen to hear why!!!!

Bill Lucas.
[redacted]

Sent from my iPhone

From: Mike Walker
To: mail
Subject: Adelaide beach management Review
Date: Sunday, 15 October 2023 7:53:00 AM

I would like to register my vote for the 'pipeline movement' of sand to local beaches.
Option 2.1

Michael C Walker
[redacted]

Sent from my iPhone

Adelaide Beach Management Review Options Shortlist - Submission

To: **URPS**

From: **(John) Charles Steer**

15th October 2023

Adelaide Beach Management Review Options Shortlist - Submission

1. Summary

I have read the documents provided on the YourSay website and reviewed them.

I was disappointed that key documents and information were incomplete especially in terms of modelling, lack of information of best practice systems used elsewhere and no apparent review of the effectiveness of the sand pumping scheme from Seacliff to Glenelg. I presume this may well have been carried out but it was not published.

On the basis of the incomplete information provided I consider the sand pumping scheme to be the most appropriate in terms of the criteria listed in Section 6.1 of the Technical Report as well as sustainability and sand conservation.

2. Introduction

I have read the documents provided on the YourSay website https://yoursay.sa.gov.au/abmr-shortlist?utm_medium=email&utm_source=cm_newsletter .they appear to include:

1. Discussion Paper

2. Part A Beach Management Review Phase 1 (Engagement Survey)

3. Part B Beach Management Review Phase 1 (Appendices)

4. Shortlisted Options – Technical Report (Draft)

3. Concerns and Comments on the Information Provided

I have the following concerns and comments which I think makes it difficult to make a fully informed decision of the optimal approach.

The information was incomplete in terms of:

- The Technical Report was a Draft only;
- There appeared to be no assessment of Best Practice approaches Nationally (eg Noosa Heads which has a sophisticated pumping system) and overseas;
- There appeared to be no mathematical modelling of sand movement for the various options including predictions for build up / erosion;
- There appeared to be no review of the effectiveness of the existing Seacliff to Glenelg sand pumping system;
- The only detailed assessment of costs was from sand pumping based on previous detailed studies – the other options used `relatively simple methods' (Section 6.1 para 2) so meaningful comparisons are dubious;
- There appeared to be no direct rationale for determining the preferred options against the criteria listed in Section 6.1;
- There was no discussion of the effects of excessive buildup of sand eg at Largs and North Haven which is also a loss of amenity for those areas. I have heard Coastal Protection

personnel prior to this review point out that pumping external sand will just result in even more build-up in the Northern Beaches

- The Criteria listed in 6.1 seemed to be incomplete. This may be because the Technical Report was a draft summary only, However I suggest adding he following qualifiers as follows as well as adding a fourth Criteria - **Sustainability** :

    1. **Maximise the amount of sand on beaches** – I suggest that this should be revised to ***Optimising*** the amount of sand on the beaches – as pointed out above excessive sand quantities also mean a loss of amenity in terms of shallow beaches;
    2. **Minimise disruption for all communities** - I think the following at least should be specified: noise, aesthetics, traffic eg structures on ends of jetties, trucks on beaches,
    3. **Avoid environmental harm** eg
        a. environmental impact of flora and fauna on sea floor from dredging;
        b. damage to dunes etc
    4. **Sustainability** eg
        a. Lifetime of external sand sources eg quarries, sea bed sand;
        b. Balancing of sand movement to optimise all beaches.

4. Conclusions and preferred option

4.1 I was concerned that the expertise of the Coastal Management Branch did not seem to be used in except for provision of information to the Consultants;

4.2 I agree with the removal of the Options for shortlisting as set out in the FAQ;

4.3 I consider that the information provided is insufficient to make a fully informed decision;

4.4 Notwithstanding the above, I prefer sand pumping[1] as this is the most sustainable option in terms of managing and conserving the sand resource and appropriately distributing it. I suggest reviewing best practice sand pumping systems to ensure minimal disruption.

(John) Charles Steer BAppSc(App Chem), GDip (Env Studies),FAIOH, CChem, COH®(Ret)



[1] I have noted that the term sand mining has been used by some respondents in the feedback, presumably as an emotive trigger. I consider that this is an incorrect term as it implies sand removal and processing as in such processes as rare earth metals. Sand pumping only involves redistributing sand from one location to another.

Submission to the Department of Environment and Water's short-list of coastal management options

Thank you for the opportunity to provide a submission on the Department's short-list.

General comments

a) Community engagement and amenity

At several points in this submission, I refer to the community's engagement with the beach and the ways this is disrupted by previous practices and by some in the current short-list. Rather than repetitively make the point, this means, among other things:

1. Elderly people who, without disruption of the beach, can safely walk along the shore. This has well documented benefits for physical and mental health. It further aids social integration and cohesion because of the social interaction it demonstratively provides. The community building impacts of easy and safe access to the beach are not, however, restricted to older people.
2. Further the action of trucks and other large equipment on beaches poses a safety risk due to the potential for pedestrians being struck by this equipment. This equipment also causes deep ruts on the beach, which are significant fall and trip hazards for people with impaired or limited mobility; this is obviously a particular risk for older and much younger children.
3. People of all age groups who wish to use the beach for swimming and related purposes, including fishing (especially from jetties), are seriously disadvantaged by several of the options outlined in the short list. Beaches and jetties should be available to all people who wish to use them, and beach management options should seek to optimize their access and amenity. Past and some proposed options also thwart people who wish to use the beach for various kind of formal and informal sporting activities, including surf lifesaving activities. Many options are unfair and unwarranted imposts on the rights of people that use beaches.
4. Finally, the large number of people who visit Largs Bay and Semaphore has been well documented. These people have the right to access a safe, healthy, and thriving beach. These visitors also represent an important addition to the local economy through the goods and services they consume while visiting these beaches. The economic welfare of Largs Bay and Semaphore beach communities should figure prominently as assessment criteria when examining these options.

b) Background to the short-list

Where is the evidence of a cost-benefit analysis of the short-list options? Has there been a systematic evaluation of the community impacts, including economic ones, of the disruption caused to beaches by these options on nearby communities and to beach goers? Such an analysis is an essential factor in beach management options and yet no evidence has of such

assessment has been presented. No information on these important topics has been provided to aid people in a comprehensive evaluation of the short-listed options. If such an analysis has not been done, it represents a remarkable short-coming in the review and consultation processes.

c) Assumptions about the northward movement of sand

The shortlist fact sheet asserts that sand moves north along Adelaide's coastline, removing sand from some beaches, including West Beach, and causing a build-up of sand on Semaphore Park, among others. It makes no mention of Semaphore beach, nor Largs Bay, while making sand removal from these beaches central to several options in the short-list. This omission is puzzling and certainly renders the shortlist fact sheet an inadequate guide to completing the survey.

Geoscience Australia data demonstrates that the coastline north of the Torrens outlet is being eroded and that the erosion is significant in Largs Bay and Semaphore beach. West Beach clearly needs a solution to its erosion. However, taking sand from eroding beaches to prop up another eroding beach is neither justified nor sustainable. What is clearly needed is a response that effectively and sustainably replenishes sand on all beaches that need it.

d) The focus of the review's assessment of the short-list

The context of repairing eroding beaches is acute given the increasing number and intensity of extreme weather events, and ongoing sea level rise. This review must therefore maintain a dual focus on remediation and promoting sustainable coastal environments for the longer term. This will also demand a high degree of flexibility for any management strategies adopted. It must also consider the interests of all people who enjoy beaches. Accordingly, the review:

- must accept the opportunity for a generational reset of coastal management. Its ultimate goal must be long-term sustainability, not merely a short-term engineering response;
- must implement responses that are flexible enough to respond quickly and effectively to the coastal impacts of climate change, including more frequent and severe storms;
- must consider the role of healthy coastlines in the social, recreational, and economic life of all coastal communities; and
- must also acknowledge that beaches do not belong exclusively to beach-side communities. All South Australians have a legitimate interest in having beaches that are not disrupted by damaging engineering measures, decimating the amenity of people living in this state.

General comments on Options 1.1, 1.2 and 1.3

A dredge-barge option, as outlined in options 1.1 and 1.2, facilitates the capacity to adjust dredging and discharge to respond to variation in the rate of erosion at individual beaches. It also facilitates flexibility by allowing movement of sand from any point on Adelaide's coast.

Option 1.1 Dredge existing sand near the shore

This has the clear environmental advantage of not damaging the intertidal ecosystem and of protecting the dunes that will play an increasingly important role in managing the impacts of climate change. It also avoids the detrimental social, environmental and community impacts of having trucks on beaches. It also provides greater protection of intertidal zones and dune systems, both of which provide ecological services that are essential to many ecosystems. It also avoids the impact of trucks on beaches, and this has environmental benefits, as well as avoiding a significant degree of disruption for beach side communities and all beach goers. The effectiveness of mass nourishment has been documented in other settings. After the initial delivery of sand, intervention would only be required every four years, which will entail less environmental and community disruption than other options. This option also offers the benefit of being able to respond more flexibly than any of the options entailing a sand pipeline.

However, it should be noted that there may be detrimental environmental consequences from this option. If dredging damages sea grass beds, it will lead to increased shoreline erosion. This will damage beaches, impair community engagement with beaches, harm intertidal ecology, and threaten the stability of dunes, thereby increasing erosion. If this option is accepted, there needs to be a comprehensive, credible, and independent environmental assessment and ongoing environmental monitoring.

I support this option on the proviso that a prior independent environmental impact assessment is undertaken, that there is independent and credible ongoing assessment of any impacts and that there is effective remediation of any impacts.

Option 1.2 Dredging using large offshore sand deposits

There is some controversy about whether suitable sand can be extracted from Pt Stanvac. This needs to be settled before this option could be adopted. In the absence of sand from Pt Stanvac being available, will the ‘shortfall’ be addressed by harvesting additional sand from Semaphore, Largs and other northern beaches? Have the environmental implications of this potentially additional harvest been modelled? In addition, this option does not specify whether the activities associated with replenishment occur for 2-4 months every year, or whether, after initial replenishment, further replenishment only occurs intermittently, as is stipulated in Option 1.1.

However, one unacceptable aspect of this action is that it will require the presence of trucks on beaches. They damage beaches, they are a hazard to people and animals using the beach, they disrupt community engagement with beaches, and they cause significant damage to the intertidal ecosystem. For this reason, this option ought not to be given consideration.

Option 1.3 Combination of dredging of offshore deposits and trucking quarry sand

Any dredging action may potentially damage the sea floor, and the ecosystem in which it is embedded. The Section banks has previously been investigated (by three different consultants) and rejected for many reasons. Increased wave action, as a consequence of sand removal risks increased erosion of mudflats, including those of St Kilda, which is an essential environment for migratory birds. t.

As with Option 1.2, Option 1.3 remains less preferred than Option 1.1 because of the presence of trucks on the beach. These have a hugely detrimental impact on communities' engagement with the beach, substantial damage to intertidal ecology, the harmful impacts on the environmental health and stability of dune systems. Further, trucks on beaches likely impose economic burdens on local businesses that depend on tourist and visitor spending.

General comments on options 2.1, 2.2 and.2.3

Options 2.1, 2.2 and 2.3 are completely unacceptable. They entail ongoing removal of sand from beaches that are already significantly eroding, and this approach has been proven to be ineffective. Further, they are not sustainable responses to longer-term coastal management. Any option associated with a pipeline entails pollution by microplastics due to abrasion of the plastic pipeline. This poses an unacceptable environmental risk because micro and nano sized plastics will be washed, along with slurry, into the marine environment, including its food chain. This is a severe threat to marine fauna, and flora. It will harm the entire marine ecosystem. For this reason alone, Options 2.1, 2.2 and 2.3 are unacceptable and should not be adopted.

The unsuitability of the sand harvested from Largs has been documented by the Department of Environment and Water. It will make the pipeline inefficient and prone to periodic malfunction. This unwelcome outcome is compounded by the fact that sand obtained from Semaphore and Larg is fine sand and, having been deposited at West Beach, will be washed away by the first significant storm. Further, the pipeline itself is likely to be adversely impacted by rising sea levels and the increasing frequency and intensity of storms. The continuous removal of top layers of sand will harm intertidal ecology. Apart from the obvious environmental harm posed by the pipeline, it does not allow flexibility in responding to changing demands of coastal management. It locks in responses that are:

- ineffective;
- expensive; and
- unlikely to respond to future needs, which will undoubtedly change.

In addition, Options 2.1, 2.2 and 2.3 are the ones that most profoundly disrupt community access to, and amenity of, the beach. The extent of this disruption is a further reason that none of these three options should be considered.

Finally, Options 2.1, 2.2 and 2.3 are extremely costly. Costly options that are also damaging to communities and beaches, are an ineffective response to sand management. Nor does the imposition of fixed infrastructure allow the flexible responses that will be essential to responding to future coastal needs.

It is not possible to offer a single positive assessment of Options 2.1, 2.2 or 2.3.

Options 2.1 Pipeline using tractors /trucks on beaches

The presence of trucks, tractors and permanent infrastructure (pumping stations) is too great on impost on beaches. It exacerbates erosion, it harms the beach environment, and the community's engagement with the beach is significantly damaged. In addition, the use of large trucks and tractors impose a safety risk for pedestrians, animals and intertidal fauna and flora. Truck and tractor activity for a quarter of every year would see the beach environment decimated and the beach rendered unusable. In addition, it specifically plans to take sand from beaches that have suffered, and will continue to suffer, significant erosion. Over time, this erosion will undermine the dunes system that will be an increasingly important buffer against the impacts of climate change. Preservation of dune systems is essential given the evidence that LeFevre Peninsula is subsiding. It is imperative that short-term engineering responses not be prioritized at the expense of measures that promote more sustainable, long-term coastal management.

There is no justification for implementing this option.

Option 2.2 Pipeline using dredge pump system on jetties

The option also removes taking sand from vulnerable beaches, with the environmental and social impacts outlined above. However, the idea of closing jetties to the public imposes utterly unreasonable burdens on communities. The jetties are both well-used and much-loved by both local communities and visitors. To be denied access to them for a significant portion of each year is an unacceptable impost on people's recreational activity. Further, it is almost certain to have an economic impact on local businesses due to declining beach visitation and the spending this generates. Further, this option is likely to increase the physical stress on jetties, both through the weight of pumping equipment and the removal of sand in their immediate vicinity. Both of these stresses threaten the long-term viability of jetties, which are a valued community resource and would require significant expenditure for their remediation. It of course also entails a sand pipeline, which is an expensive, environmentally damaging option, which also imposes significant and burdensome disruption to local communities and all beach goers.

This option imposes completely unacceptable social and environmental harms and should not be adopted under any circumstances.

Options 2.3 Pipeline using a temporary dredge

Many of the objections raised to Options 2.1 and 2.2 also apply to Option 2.3

This entails a dredge that collects sand from the near shore seabed. What constitutes 'near shore'? It is likely that this will involve near shore water being turbid, which will affect recreational use of the beach, other recreational activities, such as fishing, and with as yet undocumented impacts on the intertidal ecosystem, including its flora and fauna**.** This option also represents a significant and detrimental impact on the beach, and beachside communities, for a third of the year. This is completely untenable. A key community asset, along with its benefits for local businesses, cannot be made unusable for a third of the year.

This is another option that is expensive, ineffective and with unacceptable environmental and social harms. It should not be considered.

Option 3. Moving beach sand and quarry sand using trucks and machinery

This entails 4-6 months of disrupted beaches per year if beach sand is used for sand carting. On that ground alone, the environmental damage to the beach and dune system should exclude this option. In addition, the disruption to the community through the presence of carting equipment should also exclude this option. It markedly diminishes the amenity of the beach for beach users. It is probable that the number of visitors to effected beaches would decline, with significant impacts on local businesses, which are heavily dependent on tourism.

As it stands, this option cannot be supported.

Final comments

This review is a once in a generation opportunity to reset coastal management for all Adelaide beaches. The northern coastline of Adelaide is facing significant erosion and a just, effective, and efficient response must entail supporting strategies that benefit all beaches, not merely a few. Further, management options must be sustainable. Short-term, reactive responses would represent a massive failure to take the opportunity to develop and implement strategies that ensure the sustainability of Adelaide's coastline well into the future. Further, strategies must be capable of flexibility. One certain consequence of the impacts of climate change on our coastline is that rising sea-levels and an increasing number of storms, of greater intensity, will impose a range of challenges to coastal management that will require agile and flexible responses. For these reasons, Options 2.1. 2.2 and 2.3 must not be considered. On any criteria, they are ineffective, unsustainable and impose unacceptable environmental and community damage.

From:	Melanie Carter
To:	mail
Cc:	Taperoo Dunes
Subject:	Adelaide Beach Management Review - Taperoo Dunes Group Submission on Beach Options
Date:	Sunday, 15 October 2023 2:30:36 PM

Dear URPS

Taperoo Dunes Group would like to make the following submission relating to the 7 options put forward in the Adelaide Beach Management Review (ABMR) short list of options.

Firstly I will introduce the Taperoo Dunes group. Taperoo Dunes Group undertakes rehabilitation work along the Taperoo Dune system from Strathfield Terrace to Wandana Avenue. Taperoo Dunes Group members work hard (on a volunteer basis) to rehabilitate Taperoo Dunes. The Taperoo Dunes Group sees this work as helping to protect the foreshore, which acts as a protective barrier to infrastructure behind the Dunes. This rehabilitation work also enhances the natural habitat for native birds, insects, reptiles and plants.

Secondly, some general comments about matters to be considered by the Review Panel.

The impact of Climate change is accelerating and options must be analysed taking climate change into account.

Up to date data needs to be used when developing and assessing options for beach management.

Beach management planning along the Adelaide metropolitan coastline must be sustainable.

Environmental options, including the restoration of Seagrass in areas of beach erosion, can be a part of the solution. We would urge the Review Panel to look at a suite of options, including environmentally sustainable options, when looking at beach management along metropolitan beaches.

Mass nourishment delivered offshore would build up the beach profile of eroding beaches and could occur in a timely fashion.

Flexibility is important. As circumstances change, solutions to beach management will need to be flexible and capable of adapting to those changing circumstances.

Finally we make the following comments upon the Proposed Options by the ABMR. These comments are based upon the lived experiences of members who have lived and worked along the metropolitan coastline for decades, consideration of material throughout the sand carting and pipeline proposals over the last 3-4 years and from attending many meetings and briefing about the issues raised during the ABMR process. We have learnt much about these issues over the past few years and our group has discussed the proposed options throughout the ABMR period in 2023.

Pipeline options - options 2.1, 2.2 and 2.3
Taperoo Dunes Group strongly does Not support any of the Three Pipeline Options proposed by the ABMR.

The pipeline options propose that Semaphore and Largs Bay are both sand sources and form part of the pipeline route. We dispute that Semaphore and Largs Bay beaches can be sand sources for a sand pipeline. There is insufficient sand on Semaphore and Largs Bay beaches to feed a pipeline for even a short period of time. Very quickly damage to the proposed source beaches will become unrepairable.

Damage to beaches and dunes immediately south of Taperoo will have a negative flow on impact on the beach and dunes at Taperoo. We are of the view that the pipeline options will be the most destructive options when considering the environment.

We are very concerned about the issue of micro and nano plastics. Sand is quartz and quartz is 7 on the Moh's Hardness Scale (in a scale from 1-10, 10 being the hardest). Micro plastics and nano plastics will be created by the pumping action of the sand slurry through the pipeline. These plastic particles (including those not able to be seen by the naked eye) will be debris polluting the destination beaches. In addition to polluting the beaches, particles will be ingested by birds and other feeders along the coast. Many particles will end up in the Gulf St Vincent by wave and current action. The plastic particles will then be ingested by marine life and some will end up in the human food chain. Some particles will remain in the gulf and wave and current action will distribute them along the metropolitan coast and further out into the gulf. It's impossible to quantify the numbers of particles involved - suffice to say it will be in the many many billions. All of the pipeline options will result in 'environmental harm' by the creation and distribution of plastic debris polluting the beaches and the Gulf St Vincent.

Dunes will be destroyed along the construction route, with maintenance and servicing of the route requiring regular interference with the dunes. This will result in extensive and long term damage to the metropolitan Adelaide Dune system, including Semaphore and Largs Bay. Inundation following storm damage will be exacerbated by both the damage caused by the construction of a pipeline and the sand collection process.

To feed a pipeline, the source beaches of Semaphore and Largs Bay will be damaged on an ongoing basis and will quickly become depleted. This damage will then impact on the Dunes, as has already been seen by sand carting campaigns in recent years. This will then have a flow on negative effect at Largs North, Taperoo beach and further north.

Trucks and machinery will operate at the source and destination beaches if any of the pipeline options are implemented.

Due to impact of wave action, sand from Semaphore and Largs Bay is finer than sand found further south. This will negatively impact on the efficacy of piped sand to West Beach as fine sand will not stay on West Beach.

Sand being piped directly onto the beach at West Beach will not stay on the beach. This has been shown over decades of failed sand carting operations. A pipeline option will simply repeat this failed approach to Beach Management.

Recent Geoscience Australia data has shown that all beaches along the Adelaide metropolitan coastline have been retreating. This is very significant at Semaphore and Largs Bay.

There is an increase in the frequency of storms along the metropolitan coastline which is linked to climate change. Damage to our dunes and beaches caused by these storms places infrastructure along coastline at jeopardy. Feeding a pipeline from Semaphore and Largs Bay will further risk breaches of the dune system.

With respect to impact on the community, the pipeline options will have a negative impact on the amenity at Semaphore and Largs Bay. These Beach communities service a very wide area of metropolitan Adelaide including western and northern Adelaide (as well as regional communities who visit). In addition to the lack of amenity for casual users of the beaches, depleted beaches and damage to the Dunes and the Foreshore, and the introduction of heavy machinery and equipment, will drive away tourists and other visitors (such as wedding parties) from Semaphore and Largs Bay. Significant annual events will no longer be viable, further impacting on tourism opportunities for the region.

Pipeline options are not sustainable.

In summary, the pipeline options 2.1, 2.2 and 2.3 will cause environmental harm, will significantly disrupt the sand source and pipeline route communities and will not maximise sand on beaches including the eroding beaches.

Sand Carting - Option 3
Taperoo Dunes Group strongly does Not support the Sand Carting Option proposed by the ABMR.

Sand Carting at Semaphore and Largs Bay in recent years highlighted how quickly the beaches and dunes became damaged and were depleted. There is ongoing damage to the beaches and dunes and even now it seems that the beaches and dunes will not recover. As storms continue to increase in frequency due to climate change, the combined impact of sand carting and storm damage will have an escalating and negative impact on our beaches and dunes. This will risk inundation to the foreshore and loss of natural habitat.

As stated in the remarks relating to the pipeline options, Geoscience Australia data has shown that all metropolitan beaches in South Australia are retreating. Beaches at Semaphore and Largs Bay are retreating at alarming rates. Should sand carting start again, these beaches will be in even further jeopardy.

As mentioned in the comments with respect to the pipeline options, sand carting will have a significant negative impact on community amenity at the sand sources. Trucks and heavy equipment on the beaches will drive away tourism dollars. Communities will not be able to access beaches for long period of time.

Sand carting to West Beach has proven ineffective. Sand placed directly onto West Beach does not stay, as wave action directs it into the gulf. It does not build up the beach profile, as sand being placed offshore would. This is a failed example of beach management.

Sand carting is not a sustainable option.

In summary, sand carting option 3 causes environmental harm, disrupts communities at the sand source and does not maximise sand on eroding beaches.

Dredging options - 1.1, 1.2 and 1.3
Taperoo Dunes supports the Dredging Options proposed by the ABMR.

Central to the support for dredging options are the 2020 Dredging Guidelines prepared by the Environmental Protection Authority (SA). This important document gives us confidence that dredging will take account of environmental considerations. And dredging

will not be as disastrous as in the past.

The Environmental Protection Authority will monitor dredging in accordance with the extensive guidelines in the Dredging Guidelines.

Further, we are confident that sand sources can be found in the Gulf St Vincent and in areas adjacent to the Gulf which do not involve destruction of sea grasses by the dredging process. We understand there are sandy shoals in the gulf which would be ideal for these options. We also note that large deposits of sand at the Murray Mouth are available. We are opposed to any dredging of Section Bank, especially considering its proximity to the Dolphin Sanctuary and the Adelaide International Bird Sanctuary.

When considering maximising sand on metropolitan beaches, minimising disruption to communities and avoiding environmental harm, the dredging options are the most compatible with those goals.

Dredging will eliminate the environmental harm which would be caused by the pipeline options - that is the micro plastics and nano plastics which would be discharged onto the destination beaches and ending up in the Gulf St Vincent via the pipeline. This issue is discussed in detail in the submission relating to the pipeline options.

Dredging and discharging sand offshore will maximise sand staying on beaches. Wave action will place the sand onto the eroded beaches thereby ensuring a natural build up of the beach profile. The dredging options are the only options that achieve that goal.

Dredging is the most flexible option as sand can be deposited offshore at locations where beaches are eroded. Flexibility is important as circumstances can change.

As there are no trucks on beaches and no hard engineering on the dunes or beaches, dredging minimises disruption to communities along metropolitan beaches. Beaches and dunes would not be destroyed. Public amenity and tourism would not be disrupted.

As the dunes and beaches would not destroyed by the construction of a pipeline, and further threatened by sand collection, there would be a reduced risk of inundation.

In addition to flexibility, these options are the most cost effective and the most efficacious. Further, these options are sustainable.

Environmental impact statements and monitoring of dredging by the EPA will ensure that areas of the Gulf and beyond are not harmed in the dredging process. The significant dredging project widening the shipping channel at Outer Harbor in recent years demonstrated that dredging operations are less destructive than in the past.

Dredging options 1.1, 1.2 and 1.3 minimises disruption to communities, maximises sand staying on metropolitan beaches as it’s delivered offshore and if undertaken in accordance with the dredging guidelines and is monitored by the EPA avoids environmental harm. These options are favoured by the Taperoo Dunes group.

Can these submissions be taken into account when the ABMR is making its final report.

Melanie Carter
On behalf of Taperoo Dunes Group

Acknowledgement of Country

We begin by acknowledging and paying our respects to the Traditional Owners of the land on which Henley Beach activity and development take place, the Kaurna people. We recognise and honour their ongoing connection to this land and their custodianship over it. We also extend our respect to their Elders, both past and present, as well as to the emerging leaders of their community.

Summary

The Henley Beach Business Association Incorporated, (HBBA) has been established for over 10 years and represents members of all businesses operating in Henley Beach. Many of the members are also residents. As members, we believe that Henley Beach and every one of Adelaide's metropolitan beaches along its 30-kilometre coastline are valuable.

Ensuring that the beach, its dunes and surrounding assets of beautiful Henley Beach, are healthy and well maintained for beachgoers, businesses and residents is of key importance. This is not only true for the local and visitor economy and a buoyant property market, but also for the social wellbeing of all beach users and for the environmental impact on the local ecosystem. It is also vital to the economic viability and wellbeing of HBBA members.

We welcome the Adelaide Beach Management Review (ABMR) and we believe that the three government goals: that is, to minimize disruption to all communities; avoid environmental harm; and maintain sand staying on the beaches, are commendable. We review the short list of options with these goals in mind.

Few places in Australia excavate their metropolitan beaches, with the offshore process of dredging being the most common form of sand transfer in Australia[1]. More jurisdictions are moving from onshore to offshore systems, thus keeping their beaches open and free from heavy machinery, trucks, noise, dust and permanent infrastructure that impede sea views. This is important not only for the visitor economy and well being of all beach goers, residents and businesses, but also important for the reputation of our state.

We have reviewed the short list of options and believe dredging systems 1.1, 1.2 and 1.3 that source and transport sand offshore, rather than onshore for delivery to West Beach and other beaches where needed, such as Henley Beach, are least disruptive to all communities and therefore they are strongly supported.

We believe the Largs bay to West Beach pipeline proposals, 2.1, 2.2 and 2.3, where sand would be excavated from Largs Bay and Semaphore and transported by trucks, land based pipelines and pump stations at a number of esplanade locations, would be disruptive to many communities and the local marine ecosystem and therefore are not supported. This proposal may cause environmental harm and the sand collected may be insufficient for the sustained replenishment of sand at West Beach, Henley Beach South and Henley Beach.

We believe sand carting, with trucks on the beaches of West Beach and Semaphore for long periods are disruptive to those communities and so we do not support this option 3.0.

Implementing one option may not be the complete solution and we support the four shortlisted complementary options. That is sea meadow restoration, smart monitoring, dune rehabilitation and beneficial reuse of sand.

[1] Swash (2020): https://www.swashpd.com.au/wp-content/uploads/2022/03/SWASH_Australia_Sand-Bypass-and-Transfer-Systems.pdf.

Introduction

The HBBA, established in 2013 during the redevelopment of Henley Square, represents members of 196 businesses operating in Henley Beach. Many of the members are among Henley Beach's 6,260 residents and some reside in the wider Adelaide region.

With its beautiful beach and sunsets and vibrant family friendly cafe scene, most businesses are in the hospitality sector. There are many small accommodation providers and retailers, real estate agents, a marine discovery centre, health, beauty and other service providers. It's one of Adelaide's premier boutique beach suburbs and is popular with locals as well as attracting intrastate, interstate and international visitors year-round.

Locals and visitors enjoy the beach and jetty, strolls along the esplanade and sea views from many seafront eateries, including the heritage listed Henley Beach Hotel. Many of these eateries are less than 20 metres to the beach, and some, such as the iconic Joe's cafe, are literally steps away.

HBBA represents local real estate businesses with extensive knowledge of Henley Beach. It is one of the top three suburbs in South Australia that interstate buyers invest in, due to its pristine coastline, vibrant community, and proximity to Adelaide's central business district. Our agents also conduct business in surrounding coastal suburbs including Glenelg. As members, we believe that Henley Beach and every one of Adelaide's metropolitan beaches along its 30-kilometre coastline are valuable.

Value of our beaches:

Henley Beach is located in the City of Charles Sturt, where tourism, or the visitor economy, is one of the four pillars of the city's economy. The visitor economy is also a key economic pillar of the State. In 2022, Adelaide's visitor expenditure, which includes visitation to Adelaide's beaches, was worth $4.4 billion[2], and new data from the Tourism Research Australia (TRA) shows that as at March 2023, it had grown to $4.9 billion.

As set out in the State's Visitor Economy Sector Plan 2030, Adelaide's visitor expenditure is set to reach $5.9 billion per year by 2025 with the goal of $7.7billion per year by 2030[3]. Local visitation to Adelaide's beaches is estimated at 44 million visits per year. Should each visit generate $20, this would contribute a further $880 million annually.

When reviewing costs for sand replenishment, we do hope the value of our beaches will be considered.

Erosion at Henley Beach:

Currently Henley Beach is experiencing ongoing beach erosion with a number of stairways and ramps to the beach closed. The bottoms of some stairs are eroded, exposing the foundations which affect safety of the community when accessing the beach. The foundations of a seafront cafe are eroded. The ramp at the Henley Surf Life Saving Club is compromised. At times the ocean, even during daylight hours and at sunset, reaches the rock wall making walking or accessing the beach difficult and often impossible.

Lack of year-round access to the beach is detrimental, not only to the economic development of the area, but to the health and wellbeing of all beach users. It also affects the safety of able-bodied beach users trying to navigate the beach and rock wall at Henley Beach, and makes it unsafe and/or impossible for a range of users to use the beach, from those with mildly impaired mobility to those with a more permanent disability, and from young children to the elderly.

The visitor economy, local visitation and a buoyant property market are vital to the economic viability and wellbeing of HBBA members. Central to this is ensuring that the beach, its dunes and surrounding assets of beautiful Henley Beach are healthy and well maintained.

[2] South Australian Visitor Economy and South Australian Tourism International and Domestic performance (Dec 2022), International and National visitor survey, Dec 2022, Tourism Research Australia (TRA) https://tourism.sa.gov.au/media/wkjgintq/new-product-update-infographic_-adl.pdf

[3] South Australian Tourism Commission: https://tourism.sa.gov.au/strategies/strategies/tourism-plan-2030

The goals of the Adelaide Beach Management Review are to:

1) Minimize disruption to all communities. To us this means minimizing disruption to communities at the a) source of the sand, b) in transit and c) at the destination. This includes minimizing disruption to South Australia's (SA's) First Nations' People, particularly the Kaurna People, the traditional custodians of the Adelaide plains. HBBA recognizes the utmost importance of consultation with SA's First Nations' People.
2) Avoid environmental harm.
3) Maintain sand staying on the beach.

A) Taking into account these goals, we strongly support dredging options 1.1, 1.2, 1.3.

As sand will be collected offshore, transported by barge and delivered, in the main, to the near shore, at West Beach and where needed, we believe this would minimize disruption to all communities from Largs Bay to West Beach. We believe that offshore systems are the least disruptive to residents, businesses and visitors.

.

It removes the need for any trucks or other equipment on beaches or on local roads, minimising disruption to coastal communities and beach and foreshore users.

It will provide flexibility in delivering sand where needed, in the face of climate change and in response to future technological and environmental advances in the dredging industry.

Environmental harm to our flora and fauna and our dune systems will be avoided by an offshore system.

We understand that a range of environmental management activities, including turbidity monitoring and pre- and post-dredging seagrass surveys will be required during the works. Bluecoast's draft technical report[4] has noted that recent capital dredging works to widen the Port Adelaide navigation channel adjacent to the identified borrow area removed over 1.5 M m^3 of material and did not adversely affect seagrasses (EPA, 2020).

Delivery of sand to the near shore, rather than directly onto the beach is more effective in keeping sand on the beach[5] .

For option 1.1, sand would be dredged from the near shore of the northern beaches and delivered near shore to West Beach using a small trailer suction hopper dredge (TSHD) over 4 months. This would be repeated every 4 years with a 7 week campaign. Sand could also be delivered to other beaches where it's needed, such as at Henley Beach and Henley Beach South. Small TSHDs are available from the east coast and NZ.

For option 1.2, a "one off" large quantity of sand would be delivered as "mass nourishment" (sand engine) at West Beach over a 4 month period, using a medium sized TSHD that would likely come from overseas. It would provide enough sand to provide a buffer for 20 years. We understand that sand would be delivered near shore, onshore, and in the dunes. The sand would be placed along a 2.2km stretch of shoreline, which would result in an average widening of the beach of around 100-125m at West Beach. Whilst the beach at the delivery site will need to be closed for the 4 months, this is a "one off" inconvenience.

A similar large-scale "mass-nourishment" or sand engine system has worked well for over 10 years in the Netherlands[6] and the building of a mini sand engine was modeled for West Beach and recommended by the Danish Hydraulics Institute (DHI) in 2018[7].

---

[4] Bluecoast Consulting Engineers (September 2023) https://yoursay.sa.gov.au/88743/widgets/416316/documents/269407

[5] Biten and Zviely, (2020) Sand Beach Nourishment: Experience from the Mediterranean Coast of Israel J.Mar. Sci. Eng 8(4) 273

[6] Stive, M.J.F., de Schipper, M.A., Luijendijk, A.P., Aarninkhof, S.G.J., van Gelder-Maas, C., van Thiel de Vries, J.S.M., de Vries, S., Henriquez, M., Marx, S., & Ranasinghe, R. (2013) A New Alternative to Saving Our Beaches from Sea Level Rise: The Sand Engine Source. *Journal of Coastal Research*, 29(5): 1001-1008. https://doi.org/10.2112/JCOASTRES-D-13-00070.1

[7] DHI (2018) *West Beach Coastal Processes Modelling Assessment of Coastal Management Options.* Final Report to DEWNR, prepared by the Danish Hydraulics Institute.

For option 1.3**,** dredging of offshore sand deposits would be combined with trucking or carting of quarry sand. Whilst sourcing the most suitable sand, sand carting would be in place. We do hope that effort is expended at sourcing suitable offshore sources of sand, so that sand carting is minimised.

The dredging options are the least costly of the 7 options. We do hope however, that should sand be sourced from farther afield, funds would be made available. With Adelaide's visitor expenditure at $4.9 billion in March this year and set to reach $5.9 billion per year by 2025, we hope that the value of our beaches to the state's economy will be considered when reviewing costs of sand replenishment.

B) Taking into account the goals of the review, we strongly do not support the three pipeline options- 2.1, 2.2, and 2.3

We believe these options are the most disruptive to the communities, particularly at the source of the sand, which is at Largs Bay and Semaphore but also to the 7 transit suburbs from Largs Bay to West Beach, where pump stations would be positioned on the esplanade or in the dunes, and pipelines laid.

For each of these options, sand carting will be required for the first 5 years, which will be disruptive to both the West Beach and Semaphore communities.

There would be environmental harm from micro plastics to the marine and terrestrial environments, disturbance of plover nesting sites and potential damage to the dunes and flora and fauna.

For option 2.1 there would be a pipeline with excavators, pump stations, trucks on beaches and the esplanade. Largs Bay and Semaphore would be the source of the sand. These are recreational and visitor hot spots for the enjoyment of residents and visitors year round. There are popular hotels and venues overlooking the beaches and jetties and numerous businesses. As the source of the sand these beaches would have heavy machinery and areas of the beach would be fenced off and closed.

Beaches would be excavated for 4 months every year for 20 years. These beaches are used all year round by community members, visitors and also local educational institutions. Not having full access to the beach for a quarter of the year for the next 20 years is unacceptable for all beachgoers, from the dog walkers to the beachcombers and everybody in between.

Our real estate agents have witnessed firsthand the significant disturbance to their clients during the sale of properties near the sand excavation site at Glenelg, with the current Glenelg to Kingston Pipeline. Sand is sourced from Glenelg using excavators and sand collection units for 4 to 7 months per year, 5 days a week and this is to continue for a further 13 years. Residents describe it as "having the appearance and disturbance of an industrial zone".

During excavation the beach is fenced off and closed to the public. There's social and physical disruption to residents, business groups and beach goers. There's noise, dust, trucks and heavy machinery on the beach. that is detrimental to not only local businesses but also local residents and certainly not aesthetically pleasing to intrastate, interstate and international visitors.

To potentially have three of Adelaide's metropolitan beaches; that is Glenelg, Semaphore and Largs Bay, negatively impacted this way for at least the next 13 to 20 years, we believe should be avoided at all cost.

At each of the 7 transit suburbs there would be a permanent pump station built on, or near, the esplanade, with an underground pipeline to West Beach, affecting transit communities.

One of the pump stations would be at Henley Beach. Whilst the proximity of eateries to the shore is part of Henley Beach's charm it poses challenges, not only to the increased susceptibility to erosion, but also to the potential

location and aesthetics of sand replenishment infrastructure. The pump station with its 4-metre bulky concrete vent stack and other above ground infrastructures and concrete access holes hinders sea views and is aesthetically unappealing.

Sea views are a drawcard and are valued by businesses and visitors. The proposed pump station at Henley Beach was to be placed on a small plaza on the esplanade, changing a pleasant amenity to a utility site. It was to be placed less than 20 metres away from a heritage listed hotel, 4.5 STAR SA Tourism Award winning accommodation, and in the view of other seafront eateries, residents' homes and all visitors driving or strolling along this esplanade. The historical development of Henley Beach with its homes and businesses in very close proximity to the esplanade, Coast Park and beach, together with the narrow dunes makes it unsuitable for such infrastructure.

In the city of Holdfast Bay, each of the suburbs has large reserves that house recreational equipment and utilities. The reserves are located away from homes and businesses, thereby enabling location of pump stations in front of these reserves with minimal to no impact on residents and businesses. This is not the case in Henley Beach. In addition, dunes in Holdfast Bay are wider than at Henley Beach, allowing pump stations to be adequately hidden.

Construction of a pump station takes 4 months. The plastic pipeline was to be laid through dunes, Henley Square and a Henley Beach seafront car park with Norfolk Pines. The construction and operation of the sand pumping infrastructure would create noise pollution, increased traffic congestion, road closures and visual obstructions, all of which are detrimental to the residential and visitor experience. There would be a cost of diminished patronage.

The proposed pipeline and infrastructure is intended to be in place for 25 years. Sand management systems should be flexible to react to impacts of climate change and also to enable implementation of innovative solutions. The pump stations and pipeline, with its 25-year life span of permanent structures, are inflexible.

Keeping beaches open and free of infrastructure is an important issue for the enjoyment, physical and mental wellbeing of all beach users and important for the visitor economy. It is also important for the reputation of the state to have our Adelaide beaches open, free of heavy machinery, noise and dust, and obtrusive infrastructure such as pump stations.

So for us, in summary, we believe the pipeline system with its excavating equipment and pump station is disruptive to the community and should be avoided. They have a negative impact to amenity and they impede sea views, which are an asset. This infrastructure and its location impact negatively on the wellbeing, or "blue space" of all beach users, visitors and local residents.

There would be potential detrimental impacts on the visitor economy, local visitation, residential housing and interstate investment and property values. This would affect not only the local economy but also the state's economy as well as the state's tourism reputation.

For option 2.2, there would be a crane and jet pump or fixed jetty pumps on Largs Bay and Semaphore jetties for 3-4 months every year for 20 years, with jetty closure during this activity.

We strongly do not support closure of recreational jetties. They would be near and opposite iconic venues such as the Semaphore Palais, Largs Bay Hotel, amusement parks and recreational areas. This would be disruptive.
There would be pump stations and a pipeline to West Beach. We do not support pipeline and pump stations as detailed in 2.1
We understand a successful and socially acceptable sand bypass (forward passing) system using fixed jetty pumps has been in place at the Gold Coast Seaway since 1986. This purpose built jetty and system is out of view and very far from homes and businesses. The Indian River Inlet bypassing system in the USA uses a crane and jet pump however this system is also at a significant distance from residents and businesses. [8]

[8] P. K., Boswood, R. J., Murray (2001) *World-Wide sand bypassing systems.* Brisbane, QLD.

For option 2.3 there would be a dredge and pipeline system. Whilst the dredge would reduce heavy machinery on the beach, it would not eliminate it, we understand. There would still be pump stations and a pipeline, which we do not support as detailed in 2.1.

The costs of the pipeline options are much greater than dredging options.

C) Taking into account the goals of the review, we do not support Option 3. Sand carting
We strongly do not support the long term carting and mining of sand from our metropolitan beaches.

We do not support long term carting of quarry sand except in an emergency or as a last resort.

There will be disruption to both the West Beach and Semaphore and Largs Bay communities for 2 months, 3 times a year for 20 years, which is not supported.

However, trucking of quarry sand as a short term supplement to other strategies is necessary for management of erosion "hot spots", such as at Henley Beach, Henley Beach South and Semaphore Park.
We believe this is a separate issue to the long term sand management solutions covered by the ABMR. Should dredges be made available for management of these "hot spots" however, this may be particularly beneficial as delivery points to Henley Beach and Henley Beach South are limited. Recently, sand delivery by truck from the Torrens Outlet at Henley Beach South to Henley Beach and northern areas of Henley Beach South was stopped due to nesting plovers and protests from some community members.

There is environmental harm from trucks on beaches through the dunes and on roads. It is an expensive option.

Options that may supplement or work in tandem with main sand source(s) and delivery system(s)
We support the four shortlisted complementary options. These are sea meadow restoration, dune rehabilitation, smart monitoring and beneficial reuse of sand, such as the reuse of excavated sand from beachfront development sites for beach replenishment and dune restoration, as occurs in the Gold Coast[9] .

Conclusion

We strongly support the dredging options and complementary options.

Around Australia in 2020, the most common method of sand collection is by dredge, rather than beach excavation [1]. There's a shift in approach for sand collection from beach excavation to offshore dredging and this is now in place in Coogee, WA. Whilst Perth's Coogee Beach in the Cockburn Council used a similar beach excavation and sand collection process to the Glenelg/Kingston pipeline up until 2020, it is now using an offshore system and floating dredge. It does this in the main to reduce beach closures. There are social and economic benefits in offshore rather than onshore systems.

Adelaide was voted Australia's most liveable city and the third most liveable city in the world in 2021. This was due in part to our magnificent coastal lifestyle.

We look forward to a sand management system that minimizes disruption to Henley Beach businesses, residents and visitors and to communities of all of Adelaide's beaches, whilst replenishing sand where needed and protecting our coastline and wildlife. We hope this system or systems protects the interests of the Kaurna people, the state's tourism reputation, and takes into account climate change issues, not only for our current communities but also for future generations.

[9] Gold Coast Beach Nourishment-Reusing excavated sand: https://www.goldcoast.qld.gov.au/Council-region/About-our-city/Environment-sustainability/Protecting-our-environment/Coastal-management/Beach-nourishment and Gold Coast council's city plan: (https://cityplan.goldcoast.qld.gov.au/eplan/#Rules/0/51/1/0/0.

Peter McGregor
Largs Bay SA

Short list ABMR Submittal
15 October 2023

As a geologist who became an accidental politician, my primary focus is safeguarding Adelaide's northern beaches from outdated management practices and the risks of climate change. I currently serve as the Councillor for Semaphore Ward within the City of Port Adelaide Enfield.

My community has watched in dismay as plans for a West Beach to Semaphore/Largs Bay pipeline have unfolded, along with witnessing the devastating consequences of sand quarrying on Semaphore and Largs Bay beaches. I'm grateful that BlueCoast Engineering has suggested an alternative option – dredging (mass nourishment) – for beach management in Adelaide.

A simple stroll along our beaches reveals a stark reality: our northern beach system is receding. Despite contrary claims, current data and physical evidence paint a picture of coastline recession and landward retreat. Modern federal satellite imagery shows an average loss of 5 meters per year from Semaphore and Largs Bay beaches since 2016. Semaphore alone has lost up to 70 meters since 1993.

The quarrying of northern beach sand for carting or input into a pipeline only exacerbates these environmental issues and will cause harm to the community in numerous ways. This includes compromising public safety due to truck movements on beaches and excavations on the beach and intertidal zone. It also impacts local businesses and public amenities, with noise, emissions, beach closures, and other nuisances. It creates the potential for environmental pollution by creating nanoplastics from a quartz slurry being pumped in a plastic PVC pipeline. Additionally, it harms the natural environment, eroding coastal habitats and accelerating coastal erosion, which, in turn, could affect infrastructure and properties.

A new, sustainable approach to beach management is imperative. We need an adaptive, cost-effective approach. One that minimizes community impacts and has a track record of success worldwide. Dredging is that approach, and I wholeheartedly endorse it.

Documentation

An Advertiser article published 30 September 2023 regarding beach issues and my observations as a Geologist.

Storms blamed for 70m of sand erosion at Semaphore



Port Adelaide Enfield councillor and geologist Peter McGregor inspects Semaphore beach erosion. Picture: Brett Hartwig



Beaches all at sea

Riley Walter

One of Adelaide's most popular beaches has shrunk by 70m in the past 30 years because of an increase in significant storms, according to a top geologist.

Satellite images from Geoscience Digital Earth Australia Coastlines data set shows the Semaphore beach shoreline has been receding since 1993, with current erosion of up to 5m per year. Largs Bay beach has receded by 30m in the same period.

Port Adelaide Enfield councillor and geologist Peter McGregor said erosion has been impacting most northern beaches in Adelaide due to an increased frequency of storms.

Mr McGregor, who has worked as a geologist across the globe, said: "They're no two to five year storms, there's actually one every eight months."

He said the "one in 10 year storms" were now occurring every two to three years.

"That's why those beach reversals happen.

"Our beaches are eroding and it's due to climate change and that climate change has affected all beaches" he said.

The state government this month released a shortlist of options to combat erosion by moving sand from Semaphore or Largs Bay to West Beach after an independent review.

The options included dredging, pumping or sandcarting, with a pipeline to move the sand expected to cost up to $155m.

Dredging sand from the seabed would cost between $45m and $100m over 20 years, while keeping the current method of carting sand with trucks and excavators would cost between $100m and $110m over the next two decades.

But Mr McGregor said the sand should not be taken from beaches like Semaphore and Largs Bay, which were already severely eroded.

"The shoreline has moved landward constantly from 1993.

"The coastline is receding. It's going backwards" Mr McGregor said.

Independent Advisory Panel chairman Mark Searle said that some beaches would erode to rock and clay.

"As there is only limited new sand naturally entering the system, Adelaide's beaches have to be managed to protect homes, businesses and infrastructure from storms, and to provide sandy beaches for our community to enjoy," Mr Searle said.

"It is very important to the success of the review that it is informed by an understanding of what matters most to the community."

Mr McGregor said dredging was the most "flexible" option to combat the erosion. He said dredging was the lowest cost option, had minimal community disruption and had proved effective overseas, particularly in Holland.

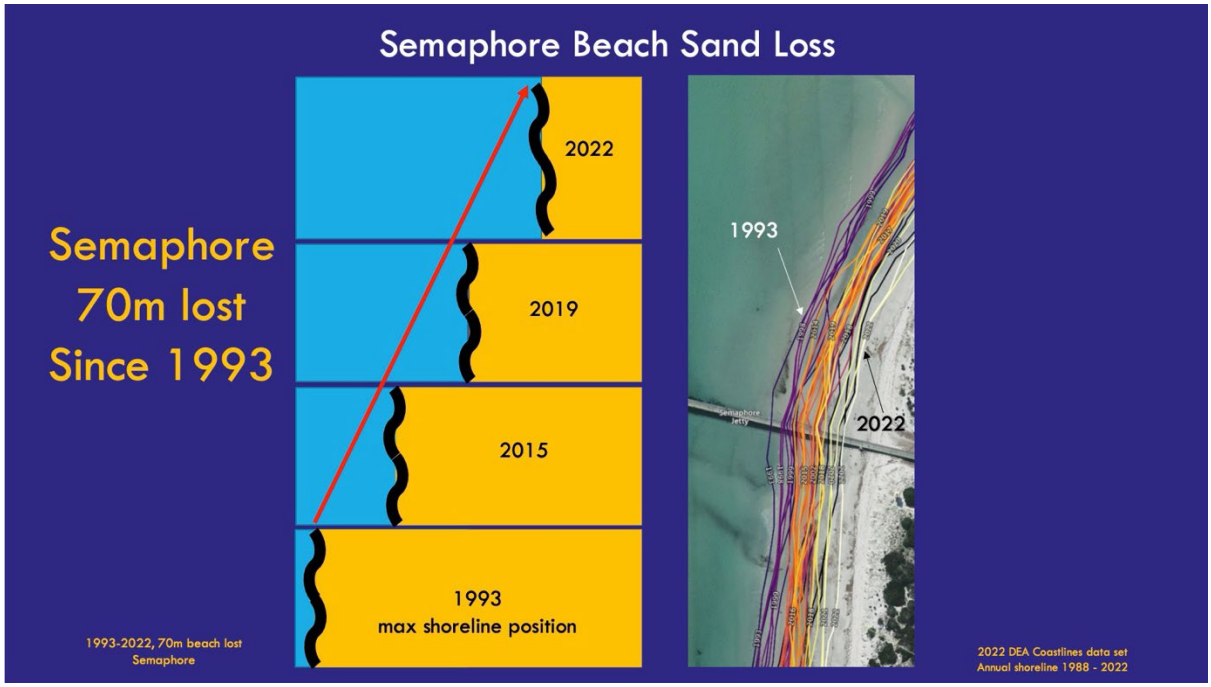
"We do not favour the pipeline as an option," Mr McGregor said.

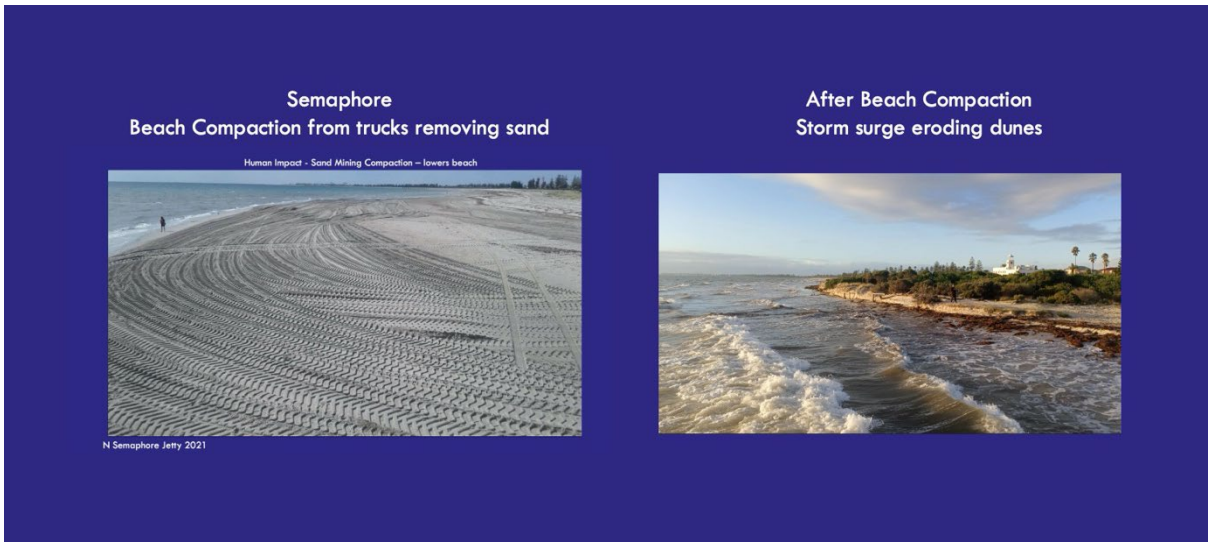
The state government last year scrapped plans for a $38.9m pipeline to pump sand from Semaphore South to West Beach.

Save Our Shores member Warwick Norman said the erosion at Semaphore and Largs Bay was "incredibly concerning".

"The Lefevre Peninsula is sinking ... and that's cause for concern," Mr Norman said.

2022 Semaphore Beach Position









Adelaide Beach Management Review

Henley Coastal Voice Short List Submission

October 2023



We acknowledge and pay respect to the traditional custodians of the land about which we are writing. We recognise the Kaurna people's ongoing connection with the land and respect their elders, both past and present and emerging.

Adelaide Beach Management Review – Shortlist Submission

As a community group Henley Coastal Voice (HCV) has been actively participating in the Adelaide Beach Management review and forums. We have grave concern for all the beaches in Adelaide and in particular the hot spots where there is continuing need for a permanent (and an immediate short term) solution to the ongoing sand that is leaving our once beautiful beaches in a state of crisis.

The lack of sand and dunes on our shores is negatively impacting local communities, businesses, tourism and of course our coastal ecology.

Bluecoast Consulting Engineers have undertaken a desktop review of previous works and have proposed a current shortlist of 3 categories, being Dredging, Pipeline and Carting, with 7 overall options as potential solutions.

HCV has assessed all the options and weighted the options against 4 criteria that we understand all stakeholders believe to be of utmost importance in making our recommendation.

A. **Minimise disruption for all Communities**
B. **Avoid environmental harm**
C. **Maximise the amount of sand on beaches**
D. **Cost**

We have, whilst evaluating against these criteria been mindful of flexibility, so you may note comments to this in our submission. Additionally, we make comments in places to highlight some immediate needs to some beaches so that we are clear that whilst supporting a sustainable long-term solution we need an immediate option to the current crisis, especially as we approach summer.

We strongly believe dredging is the most effective and proven solution. In particular we believe that the option listed as 1.2 'Dredge using large offshore sand deposits' is overall the most effective dredging option with 1.1 'Dredge existing sand near the shore' as the next best solution. Dredging has the least disruption to communities both short and longer term, it maximises sand on the beaches, minimises environmental impact, is more cost effective and more flexible should climate change and other factors bring unforeseen problems to this area of coastline.

Dredging Options

HCV has assessed the three dredging options proposed and have a very strong view that of all the 7 options *dredging is the most favourable and cost-effective long-term solution to address the sand shortage on Adelaide beaches*, w*ith **1.2** Dredge using large offshore sand deposits, **as our absolute preferred and recommended option.***

The dredging options were:

1.1 Dredge existing sand near the shore
1.2 Dredge using large offshore sand deposits
1.3 Combination of dredging offshore deposits and trucking quarry sand

HCV assessed the 3 dredging options and weighted the options against the criteria that we mentioned earlier: A, B, C & D.

Criteria A: Does the solution minimise disruption to all communities?

1.1 This option of dredging existing sand near shore is quite favourable, and is our second ranked preference, behind 1.2. provided that suitable areas and quantities of sand can be located and have a negligible environmental impact.

This option minimises disruption to communities, as there is no onshore infrastructure to build or maintain. The proposal is for an initial large deposit of approximately a 15-week duration, with top ups every 4 years, of about a 7-week duration. As these works are not onshore, there should be minimal disruption on the foreshore, or to beach goers even if the timeline is extended.

1.2 We assessed dredging using large offshore sand deposits to be the very best overall solution not only of dredging, but all 7 options.

This dredging option is very favourable, and our outright recommendation and preference.

It minimises disruption to communities, there is no onshore or fixed infrastructure to consider and the dredge is located 2km offshore so has minimal visual impact. The option has a distinct additional advantage in that there are many more suitable areas to source sand and some of these areas have already been environmentally impacted by the dumping of surplus sand from prior dredging operations. The proposal is for a once off mass nourishment of approximately a 15-week duration. As these works are both a once off occurrence and not onshore there should be minimal interruption on the foreshore, or to beach goers, as well as minimal visual impact. The deposits being offshore would workaround any concerns such as those that have been raised by protestors regarding the trucking movements and the beach ecology.

1.3 Combination of dredging offshore deposits and trucking quarry sand. Although this has significant benefits, we see that the use of trucks on beaches creates disruption to communities, creates additional environmental harm as well as hazards and although it gets sand on beaches it also has a higher cost. The trucking to supplement required sand means additional sand carting from quarries for this solution, which adds to the amount of disruption and negative environmental impacts to Adelaide road users, the West Beach and/ or other beach recipients, the community and the public who wish to use the beaches during these times. This 'trucking' is realistically a tactical option that needs to be considered for urgent supplemental top ups such as is required now at Henley South and Henley Beach and of course upon any major weather activities that create the need. As a result, we rank this dredging option as the least favourable dredging option however better than either a pipeline solution or sand carting.

Criteria B: Does the solution limit environmental harm?

1.1 The environment needs to be considered and this option is slightly less favourable than 1.2, particularly as it is proposed that nourishment works are undertaken in winter or autumn to minimise the impact on seagrasses. We acknowledge that Bluecoast has recommended environmental impact studies that would require assessment and likely to require dredge plume modelling, ecological (seagrass) surveys and baseline monitoring (water and possibly noise quality)

Bluecoast acknowledge that this could be completed within a 12-month period (2024) during which time ongoing sand carting from quarries has been assumed to continue.

1.2 & **1.3** The environment needs to be considered however this is the case for all 7 options and 1.2.&1.3 one minimises this potential harm. It is proposed that the mass nourishment works are undertaken in winter or autumn to avoid negative impacts on seagrasses.

1.3 Additionally, this has a larger environmental impact because of trucking's carbon emissions, fuel consumption, roadwear and impact on the beaches when delivering sand.

Criteria C: Will the solution maintain sand on beaches?

1.1 In addition, dredging with nearshore deposits certainly maximises sand on the beaches with an initial deposit and then proposed top-ups every four years (we assume this timing would be monitored and that it should be flexible in need).

1.2 It again maximises sand on the beaches as the deposit is very large. This option of dredging looks to be the most flexible in where the sand can be sourced and also in the quantities it can provide, and again we have assumed that the sand can be deposited where it is needed as the deposits are made via a floating pipeline from the dredge to the beach. This flexibility is important as all these options focus on West Beach, however for this long-term solution to be effective there should be critical analysis of the beaches in most need as this can change over time especially where short term solutions have not been delivered.

We are also aware that in order to achieve constant sand replenishment along the beaches north of the river Torrens outlet that a deposit of material large enough to create a "sand engine" is required.

Criteria D: Cost

1.1 & 1.2 The costs of these two dredging options are the most economical of the 7 options short listed for submission.

We have a preference for 1.2 in terms of its sand source options however it is being proposed as a one-off event and we are concerned that as proposed it lacks flexibility to deliver sand to areas along the coast that will almost certainly be required after storm events at intermittent intervals (not wait a further 20 years) or as a result of ongoing climate change and sea level rise. Option 1.1 is better in terms of its ability to deliver sand at interim intervals to beaches along the coast that require a top-up however it seems restrictive in options to sand source.

The costs are favourable for both with 1.1 & 1.2 being close in estimated costs, and overall, far more fiscally viable than any of the other options on the short list.

1.3 This is a higher cost option as it adds the cost of trucking to both the other dredging options. We agree that this carting of sand by truck needs to occur for the interim as we have a critical situation on Henley South and Henley Beach however this element should only be used in an interim and or urgent need.

We would also like to highlight the need for flexibility, as an example, sites North Haven & West Beach are stated in the report, although these may not be the appropriate future sites for sourcing or deposits. We believe the dredging options with floating pipelines from the dredge to the nearshore deposit location have the flexibility to consider other sites as deemed more appropriate for sourcing or depositing at the time or as needed with priority.

Pipeline Options

HCV has assessed the three pipeline options proposed and have a very strong view that of all the 7 options *pipeline is the least favourable and cost-effective long-term solution to address the sand shortage on Adelaide beaches*.

The Pipeline options were:

2.1 Pipeline using tractors, excavators & trucks on beaches

2.2 Pipeline using dredge pump systems on jetties

2.3 Pipeline using a temporary dredge

HCV assessed the 3 Pipeline options and weighted the options against the criteria that we mentioned earlier: A, B, C & D.

Criteria A: Does the solution minimise disruption to all communities?

2.1 We rated this lowly because of the disruption that will occur at the site of sand collection through the use of trucks, scrapers, trommels and machinery on beaches for months of the year. The public will be excluded from these areas and experience at Glenelg has shown that the word 'temporary" has blown out to mean 6-7 months of the year. There will be further disruption at the slurry formation station where sand is mixed with water to allow it to pass through the pipeline. Noise will also impact residents and the general public wishing to enjoy the area.

Further disruption will occur during the construction of the pipeline in that there will be trenches dug through beaches, dunes and road /footpaths. Pumping stations will be established which will necessitate further major construction and their associated cooling towers will permanently obstruct views and degrade the amenity of a number of areas as well as devalue properties in close proximity. Unlike the southern pipeline, where cooling towers have been placed in front of reserves and open areas, usually at least 100metres from homes, with vegetative buffers, the northern pipeline proposal has placed pumping stations near residential properties and will detract /interfere with the beach amenities. The original northern pipeline design had the Henley Beach pumping station within 20 metres of houses and a heritage listed hotel, which is totally unacceptable. The pipeline will also pass though Henley Square, disrupting that vibrant business community for a significant period of time.

Maintenance would require ongoing disruption to the community and residents depending where the maintenance issues occur. This disruption will occur over the entire distance of the pipeline, and lifetime of the project, affecting many communities.

2.2 We rated this option even lower than 1.1 against these criteria because as well as the same disruption associated with pipeline construction and maintenance, the collection of sand from the jetty areas would also mean closure of these jetties for 3-4 months per year and this could easily blow out to longer if sufficient sand cannot be collected. To supplement sand, the need for additional sand carting from quarries is part of this solution, which adds to amount of disruption to Adelaide road users, the West Beach community and the public who wish to use the beaches during these times.

2.3 Although we consider that this option will still cause significant disruption to communities, we rated this option slightly higher than the other 2 pipeline options against these criteria because the disruption to the northern beaches is lessened because some sand collection is offshore. However, the issues associated with construction, maintenance, sand carting and deposition on West Beach are still highly disruptive to all communities along its length, and therefore are not acceptable.

Criteria B: Does the solution limit environmental harm?

2.1 We rated this solution very poorly as we believe that the environmental harm caused by trucks on beaches, scraping of sand, elimination of seaweed, trench digging, and damage to dunes will have a devastating impact on the environment and coastal flora and fauna. The additional micro-plastics that will be introduced into the coastal system will have an ongoing impact on our coast and sea environment.

2.2 As well as all of the above, this option also includes additional environmental harm due to the introduction of quarry sand carting and deposition by trucks onto West Beach. The huge use of diesel, deposition of tyre rubber and wear to roads and beach accesses all contribute to environmental harm.

2.3 We rated this option slightly higher for these criteria than the previous two due to the collection of sand being offshore, rather than on beaches. However, the environmental harm is still evident by the need to have infrastructure on beaches for collection and processing before the sand is added to the pipeline, which again, has all the issues associated with its construction, running and maintenance and micro-plastic pollution. This option also has the issue of trucking quarry sand and deposition onto West Beach as outlined above.

Criteria C: Will the solution maintain sand on beaches?

2.1, 2.2, 2.3 We rated all three of these options in the lower-range of our scores because we believe that by depositing sand directly onto beaches, the rate of erosion

will actually increase when compared with a strategy of depositing it into the near-shore (Reference 1. Biten and Zviely) [1].

If the rate of sand erosion increases due to increased storm activity, sea level rise and increased beach angle, more sand will be required from the northern beaches and quarries. All of this creates more pressure on the environment and on communities.

We are concerned that both the quantity and quality of sand that can be gathered from the northern beaches may not be appropriate. Our experience with the 'on the run' changing of the 2020 design of the northern pipeline and the experiences of Glenelg residents, who were told that the sand gathering infrastructure would be a temporary inconvenience for the southern pipeline, has now become months of noise, dust and beach exclusion has left us feeling that more and more sand will be required to feed all three northern pipeline solutions.

Criteria D: Cost

All three Pipeline proposals have the highest costs over a 20-year period. This will limit its flexibility and amendment if coastal conditions change or additions are needed. South Australian residents expect our government to use our money in the most efficient and effective way, which the pipeline project does not, and as a result we rated all three of these options poorly against the 'costs' criteria.

[1] Biten & Zviely. Sand Beach Nourishment: Experience from the Mediterranean Coast of Israel J.Mar. Sci. Eng 2020 8(4) 273

Lack of flexibility

All three pipeline proposals rely on a fixed pipeline and a series of pumps to deliver sand onto a beach. There is minor flexibility to add in another outlet along the pipeline if a hot spot needs to be topped up, but that would require more construction, more sand from other beaches or from quarries and perhaps more pumping stations. We see these options as inflexible, particularly when we factor in the high costs of the initial project which may limit the ability to maintain the project or add variations along the way.

For all of the above reasons, *Henley Coastal Voice views the three pipeline proposals as very low in satisfying the criteria of the Adelaide Beach Management Review.*

Carting

HCV has assessed the carting option proposed and have a very strong view that of all the 7 options ***carting should only be used as a short-term or emergency solution.***

3. Moving beach sand and quarry sand using trucks and machinery

HCV assessed the Carting option and weighted the option against the criteria that we mentioned earlier: A, B, C & D.

Criteria A: Does the solution minimise disruption to all communities?

We rated these criteria low because sand collection at Semaphore South and Largs would involve trucks and sand collection machinery on beaches creating disruption to local residents and beach goers. Careful selection of collection sites and localising access to trucks it would be needed for this activity to occur, creating disruption to beach enjoyment and access.
Trucks travelling south on Military Road/Seaview Road would create an unacceptable increase in heavy traffic there, if trucks were to use Tapleys Hill Road they would have a proportionately smaller increase in heavy traffic. The transport of sand in from quarries would similarly cause a percentage increase in traffic on major roads and impact local traffic over 4-6 months each year. West Beach residents and beach users will also experience disruption as sand is delivered onto the beach by truck.

Criteria B: Does the solution limit environmental harm?

We rated these criteria low as collecting machinery and trucks on the beach risks causing environmental harm due to the destroying of beach ecology and dune fauna and flora habitats. An Environmental Impact Study would need to be done to ensure that the collection and transport of sand did not create significant environmental harm.
The collection, transport and placing of sand will initially be undertaken by heavy diesel machinery and hence, will produce emissions of carbon dioxide to the atmosphere.

Criteria C: Will the solution maintain sand on the beach?

We rated these criteria to in the mid-range level because, although this option requires at least annual repetition to be successful, it is the currently used system of sand management and has some flexibility in location and frequency, such as, after localised damage by a storm event where additional carting could be quickly introduced. NB. although Henley has recently found that this flexibility was stopped by protesters. A safe beach profile can be created with sand placed around rock revetments and other structures which are currently being undermined.
The volume of sand that could be moved is less than with dredging methods, by shifting the existing beach sand southwards sand carting attempts to recreate a system which existed before it was interrupted by multiple man-made structures.

External sand is still needed to ensure that enough is deposited in the required areas.

Criteria D: Cost

The cost of this method is quoted as $100-$110m for the 20-year proposal. We note that it is in the mid-range of the short-listed options and as a result we rated it in the mid-range for this criterion.

In summary, sand carting should only be a short-term, or urgent option

- The equipment and infrastructure are readily available.
- The solution can be implemented at very short notice – refer the recent commencement and then cancellation of carting from the Torrens outlet and change of deposition site.
- The system has successfully placed sand at West Beach and, on a smaller scale, the short forward carting of sand from the Torrens outlet to Henley Beach in the past.
- This solution is flexible in its points of sand collection and distribution as well as volume moved by varying the number of trucks and equipment used, and the frequency of operations.

However, there are constraints because of:

- The amount of disturbance to beaches and communities
- The environmental impact on beaches and roads
- Availability of access to beaches by trucks
- The long-term availability of appropriate sand

We are concerned that while the government considers the Bluecoast report, assesses the public's feedback, researches sources of offshore sand and finalises contracts, time will go by and our beaches will be irrevocably damaged. Some are already in crisis; short term solutions must be adopted in the meantime.

We encourage the state government to take a bold state-wide view that all Adelaide beaches are an important part of our tourism, business and recreation and coastal ecology. As such, we need the best solution for all beaches along the metropolitan coastline.



In summary, we strongly believe dredging is the most effective and proven solution. In particular we believe that the option listed as 1.2 Dredge using large offshore sand deposits is overall the most effective dredging option with 1.1 Dredge existing sand near the shore as the next best solution. Dredging has the least disruption to communities both short and longer term, it maximises sand on the beaches, minimises environmental impact, is more cost effective and more flexible should climate change and other factors bring unforeseen problems to this area of coastline.

We also believe that complementary strategies, as outlined in appendix 1, are important to ensure the success of any long-term solutions.

APPENDICES

Appendix 1.

Complementary Strategies

We agree with Bluecoast's report that complementary strategies can enhance the effectiveness of all shortlisted options.

We believe that it is important to include and budget for these strategies as part of any long-term solution and strongly support the use of these strategies.

Seagrass Restoration: Activities such as the "Seeds for Snapper" program are growing in participation and effectiveness.

Sand drift fencing: These fences are used worldwide to cause windblown sand to drop creating small dunes around them which are later colonised by coastal plants. These fences have a secondary advantage in that they restrict human access and disturbance of the dunes by foot traffic. There are, in places along the Henley Coast, the tops of posts from old drift fence which attest to their efficacy. This work was in most part effective over 30+ years in building up now vegetated dunes immediately north of the outlet and maintaining a dry sand beach in all but the worst storm events.

Smart monitoring: We take this to mean the use of up-to-date technology, such as Lidar, to provide real-time, relevant data to assist planning and implementation of solutions both short and long term. This is vital for effective planning and implementation of solutions.

Dune rehabilitation: Additional sand and plants can be added to ensure the dunes stay viable as barriers to erosion and as habitats for coastal fauna.

Reusing excavated sand from construction sites for dune restoration and beach replenishment: The Gold Coast Council has regulations for builders and developers which require the return of excavated sand from seafront building sites to the council. This sand is stored for future storm response or placed in the intertidal zone to allow natural distribution along the coastline, for dune restoration and beach replenishment. With continued development and redevelopment along Adelaide's metropolitan beaches, this may be a sustainable source of sand to consider for dune restoration and beach replenishment. For example, the Fort Largs development on the Taperoo Esplanade, subdivisions along the coast at West Lakes Shore, Henley Beach, Semaphore and in many of our coastal suburbs, and also in the nearby regions, particularly along the Fleurieu Peninsula.

Appendix 2

Current Scenario, West Beach – Henley Beach

Referring to the report by Bluecoast, Henley Coast Voice must strongly raise the point that this report seems to continually refer to placing sand at West Beach as the required end result.

We know as locals and regular beach goers that sand from West Beach does not currently build up sand reserves at Henley and Henley South. As previously mentioned, the man-made Torrens outlet as well as the West Beach boat ramp and the West Beach Surf Club revetment wall act as groynes that impede northerly sand movement. Intervention is needed to move sand around these barriers.

This problem was identified 30+ years ago by Dr. Bob Culver and the Director of the Coast Protection Board, Dr. Rob Tucker. Thanks to their expertise this issue was managed well by annual sand carting to Henley across the Torrens outlet for a short time each year until it was stopped four years ago. Having the flexibility to place sand in areas of need (Hot Spots) is an important factor in whichever solution is selected as part of this review.

Appendix 2.1

Short term needs for sand carting intervention

While it would appear that sand dredging by barge appears to be more cost effective and less disruptive, we of the HCV are at pains to suggest that this system will take some time to establish. Meanwhile, Henley Beach is in a TERRIBLE state, with the rocks of the revetment wall being undermined, dangerous and loose.
Beach goers (of whom there are many) are frequently bitterly disappointed to find no beach at high tide, and rocks protruding dangerously at low tide. This problem will only generate more concerns and unhappiness as summer progresses and beach crowds increase. Lack of beach width will particularly affect the visitors to the very popular Henley Square.

We ask that sand be transported as soon as possible by truck to the beach between Lexington Street and North Street, which is the worst affected area. This section was promised sand deposits in August and then stopped to protect the nesting sites of hooded plovers. We are hopeful that this operation can be undertaken by adopting strategies such as marking and fencing the nests, or other options to address the urgency in Henley South and Henley Beach.

Economic and Environmental Sedimentology

Principal: Dr Ian Dyson
Coastal and Environmental Geologist
[redacted]
E: [redacted]

To: UPRS

From: Ian Dyson Date: 15th October 2023

Re: Review of management options along the Adelaide metropolitan coastline.

I have raised a number of issues herein that I would like considered during the course of public consultation. I would appreciate the opportunity to present to the Independent Advisory Panel if there is interest in my views.

Thank you for consideration of my submission.

Yours sincerely



Ian Dyson

Background to this Submission

Dr Ian Dyson has a very long association with Adelaide's beaches, in particular Hallett Cove, Moana on the mid-south coast and Waitpinga and Parsons Beach on the far south coast. He grew up at Christies Beach where he was a patrolling member of the Christies Beach surf club and a member of the SA State Team in 1974-1975, and then Brighton Surf Club where he was Club Coach. He has a PhD in marine sedimentology from Flinders University. Post-doctoral research at Adelaide University focused on the effects of changes in sea level and sediment supply on the coastal environment. This was followed by a major research project on heavy metal and effluent contamination in the Onkaparinga estuary for the Onkaparinga Catchment Board. Recent research has shown how beaches recover from major storm events. A unique sand-bag groyne field design has been developed to remediate coastal degradation based on how healthy beaches heal themselves. He has been asked recently to investigate their application to a number of beaches on Yorke and Eyre peninsulas, and at West Beach by the City of Charles Sturt.

Comments on the Review of Coastal Management Options along Adelaide's Beaches

Introduction

Bluecoast Consulting Engineers were commissioned to carry out an independent scientific review of coastal management options along Adelaide's beaches.

The review was to include consideration of:

1. How to manage sand on Adelaide's beaches to minimise disruption for all communities, avoid environmental harm and maximise sand staying on beaches.
2. The Adelaide community's views on sand management options and on the impact of the current sand management approaches, including trucking and pipelines.
3. Lessons from international and interstate examples of sand management on metropolitan beaches.
4. What can be learned from the most up to date analysis of climate science about future management of Adelaide's beaches.

The shortlist of options does not cover any scientific aspects. Rather, it is a review of engineering options. Further, the costing for each option is very loose and dependent on such things as availability of dredges and locating a suitable sand supply.

It is hoped that details of scientific aspects are provided in due course so that there is an opportunity to make further comment and submission.

The comments as outlined here follow on from my submission dated 9th June 2023 titled "***A Scientific Approach to the Management of Adelaide's Beaches***".

Short List of Options

There are 3 options that include dredging, 3 options that include a pipeline and another option that includes trucking.

Option 2.1 "***Pipeline using tractors/trucks on beaches***" is considered the only viable option where the number of intake points (doubling as discharge points) is minimal in order to reduce traffic of vehicles and machinery on the beach.

The retention of replenished sand, as referred to above, has not been addressed in the review of coastal management options. It needs to be addressed, especially from a scientific and not engineering perspective. Modelling needs to be based on the science.

Dredging options are discounted because of the environmental impacts. They will also be buried in various long-term impact studies.

Comments

The sourcing and supplying of sand is the cornerstone of the Adelaide Living Beaches Strategy w*here:*

1. *Existing sand supplies are recycled more effectively using sand slurry pumping and pipelines, which minimises the need for trucks to cart sand along beaches and suburban roads.*

2. *Coarser, more stable sand is added from external sources such as Mount Compass.*

3. *Coastal structures such as groynes and offshore breakwaters slow the northerly drift of sand.*

Sand replenishment during the winter months is inefficient and expensive. Furthermore, certain species of sea grass won't tolerate turbidity (caused by dredging) at different times of the year. These impacts need to be assessed by qualified scientists.

An enormous amount of sand has built up seaward of the shoreline in particular between the Semaphore and Largs jetties. At the same time dune sand has accumulated to extreme levels along the same stretch of coast. In fact, sand has built up north of Grange jetty where transverse bars have formed due to an oversupply of sand as shown below. In hindsight this should not have been allowed to happen. A whole – of – coast approach is required.

It's imperative now to greatly impede the rate of longshore drift. Sand needs to be retained within optimum-sized beach cells. If longshore drift is reduced, ideally to circa 1986 levels, there should be a major reduction in the sand budget. If the rate of longshore drift is not reduced, options such as mass fill will be neither efficient nor economical.



Transverse bars seen as protruding fingers of sand oblique to the low-tide shoreline that represent a potential source of sand north of Grange jetty.

Adelaide Beach Management Review Options Shortlist Submission

15th October 2023

Submission supported by:

- **Experiencing Marine Sanctuaries (EMS)**
- **Dr Janine Baker, Marine Ecologist**
- **Dr Mike Bossley, Marine Biologist**
- **Dr Anthony Cheshire, B.Sc. Ph.D, Principal-Science to Manage Uncertainty, Inaugural recipient, SA Conservation Science Award (2023).**
- **Faith Coleman - Federation University Australia / EcoProTem**
- **Peri Coleman - Principal Consultant, Delta Environmental Consulting**
- **Dr Alice Jones, Senior Lecturer in Resilience Ecology, School of Biological Sciences, The University of Adelaide**
- **Ms Patricia von Baumgarten – B,Sc. Oceanology and non-practising Solicitor/Barrister, MSc. Coastal Management, MSc. Public Policy and Management, MEd. Evaluation and MLaw Juris Doctor**

We **strongly support** **option 2.1 - Pipeline using tractors/trucks on beaches.**

We strongly **do not support** all other options:

Option 1.1 - Dredge existing sand near the shore.
Option 1.2 - Dredge using large offshore sand deposits.
Option 1.3 - Combination of dredging offshore deposits and trucking quarry sand.
Option 2.2 - Pipeline using fixed jet pump systems on jetties.
Option 2.3 - Pipeline using a temporary dredge.
Option 3 - Trucking sand from beaches and quarries.

Rationale

Strongly support **- Option 2.1 - Pipeline using tractors/trucks on beaches**

This option is the current system now successfully operating for the last ten years and chosen after several studies and investigations carried out before and after the inception of the Coast Protection Board in 1972, which considered options for beach replenishment. These studies confirmed that there is no known source of suitable sand for beach replenishment offshore the Adelaide metropolitan coast. Therefore, any options that consider bringing sand from offshore are hypothetical. Recycling sand via the pipeline is the most sustainable use of this finite resource and has the advantage of allowing sand to be directed where it is most needed (e.g., where access by trucks and tractors is not possible or difficult).

We are not sure what is meant by extensive research of beach sand replenishment interstate and internationally being done. The point is that the relevant research should be done considering the local systems, done locally, and not by attempting to extrapolate other studies to SA (whilst ignoring decades of relevant work done her in SA). The technical information presented in the YourSay website ignores very important aspects of coastal processes in the Adelaide metro coast and its ecosystems, which have been subject of many studies for over decades that informed the decision to use the pipeline as the best option.

For example, a fundamental aspect that must be taken into account when considering beach replenishment along the metro Adelaide coast is the amount of dead seagrass, which is part of the natural system. The benefit of using a sand collection machine on the beach is that it can avoid dead drift seagrass which otherwise would impair water quality in the sand discharge that could lead to environmental nuisance. The sand collection machine collects sand without the dead seagrass because a loader/bulldozer can push the dead seagrass aside prior to the collection of the sand. In comparison, a dredge entrains dead seagrass in the sand, which then needs to be screened out requiring screening machinery on the beach.

The potential impacts on coastal and marine ecosystems of this option are limited due to the nature of the pump/pipeline operation when compared to the dredging options. Furthermore, the social impacts of damages to ecosystem services caused by dredging, like the loss of seagrass as nursery areas, should not be underestimated and must be considered. It was not possible to locate any information about the proper accounting of either the true financial cost (taking account of the the likely future cost of diesel vs electricity). Furthermore, there has been no credible accounting of the carbon footprint of the various alternatives. Any meaningful assessment of the carbon footprint of the various options is likely to show that the pipeline option is by far the least damaging.

There are limited collection areas with tractors /trucks, whereas along the pipeline there are offtakes so that relatively small amounts of sand can be discharged at many locations, reducing the need for more machinery on the beach or trucks trundling through the streets.

Strongly do not support - **Option 1.1 - Dredge existing sand near the shore**

The proposals for dredging would most likely have impacts on nearshore systems with high conservation values (e.g. Section Banks), Marine Park, Aquatic Reserve< Adelaide Dolphin Sanctuary and obviously impact on the environmental values of these systems. Please refer to the report *The Section Bank: Ecological Communities and Strategies for the Minimization of Dredging Impacts* 2002, by Dr Anthony Cheshire et al when Section Banks was being considered for dredging. The repot, commissioned by the SA Government, describes the ecological communities of the site and potential impacts of dredging.

It would appear from the consultant's technical report that the dredging options proposed are from experience on the East Coast of Australia, which are significantly different from the conditions along the Adelaide metro coast, primarily because of the extensive seagrass beds. Furthermore, the dredging options are not to varying extents sustainable compared to recycling sand and require significantly more diesel as the motive fuel. There is a high risk that the dredging options will cause unacceptable turbidity in nearshore areas affecting bathing water quality, and further offshore adverse impacts on reefs and seagrass meadows.

Dredging sand near shore is strongly not supported because of the potential damages to marine ecosystems such as seagrass and reefs. Where seagrass is lost, there is an expansion of blow outs, thus impacting on the erosion and deposition processes along the coast. The loss of seagrass exacerbates beach erosion. The SA Government has spent a huge amount of taxpayer's money during the last two decades, at least, trying to understand the causes of seagrass loss in metro Adelaide coast in order to bring them back. In November 2007, CSIRO published the final report of the Adelaide Coastal Waters Study (ACWS) prepared by the EPA, which described in detail the impacts of water quality (including sedimentation) on seagrass ecosystems along the coast. This six years comprehensive study served as the basis of many initiatives to improve water quality, so coastal ecosystems could recover. Prof David Cox, Director of the ACW study, noted in Volume 1 of the final report:

> *'Sediment movement inshore of the seagrass beds is presently sufficient to prevent regrowth of seagrasses. Amphibolis has been shown to recruit to patches of sacking and other rough materials anchored to the bottom – in this way a recruitment source is available to support future recovery if conditions are conducive to recruitment and subsequent growth. Even so, recovery is expected to be slow. In other parts of the world, it has taken up to 20 years for seagrasses to regrow once suitable conditions were re-established, and for both Posidonia and Amphibolis–dominated systems this timeframe may exceed 100 years. Large– scale recovery of seagrass meadows should not be expected unless dramatic and lasting reductions in coastal inputs are made. Even then, sediment instability and nutrient recycling may inhibit progress towards this objective. While evidence of modest (unassisted) recovery in the vicinity of decommissioned sludge outfalls has been noted, it is more likely that that large-scale recovery of seagrass meadows along Adelaide's coast will require intervention, either in the form of provision of appropriate settlement substrate for seedlings, transplanting of mature stock, or the harvesting and planting of germinated seedlings'.*

The study also demonstrated *that the nearshore region of the Adelaide metropolitan coast has water clarity characteristics which are detrimental to seagrass species. Highly variable and low light levels are strongly associated with land-based turbid inputs. Productivity modelling has provided a demonstration that these characteristics cause low productivity and may have been responsible for the loss of seagrass beds from this area. Whilst photokinetic studies are required to draw this conclusion with greater confidence, this study has failed to rule out the possibility, and has demonstrated that, at the very least, these conditions represent a serious stressor for seagrass beds in the region. It has also highlighted the need to concentrate research on this dynamic region, where seagrass beds may be continuing to recede seawards, remaining stable, or beginning to revegetate after documented historical losses. Optical water clarity, through its effect on productivity, is likely to be an extremely important variable to consider* (refer to ACWS Technical Report number 12).

The SA government spent millions on the ACWS working out the reason for seagrass loss and implementing solutions to manage the threats including putting in better sewage treatment to reduce nutrients that caused coloured water from algae blooms (Adelaide Coastal Waters Water Quality Improvement Plan), and millions of dollars more, through the Catchment to Coast project trying to reduce sediment and coloured dissolved organic matter reaching the sea in stormwater. There are ongoing projects dedicating much effort to restore seagrass beds. Together with the efforts to reduce sedimentation and nutrients into coastal waters, efforts to rehabilitate seagrass have been ongoing. The SA Government has been investing in seagrass planting for rehabilitation purposes. The seagrass restoration project is an initiative of the SA Government that has been in place for the last 15 years, and continues the restoration effort along Adelaide metropolitan beaches.



Source: https://www.environment.sa.gov.au/topics/coasts/explore-and-learn/seagrass-restoration-in-sa

Recommendation #14 of the ACWS states *that Adelaide's coastal marine environment must be managed as a component of a system that integrates catchment management, urban and rural land use, demographics, urban and industrial development, climate change/climate variability, and water re-use.* Therefore, the choice of sand sources cannot be seen in isolation from its impact on surrounding systems.

In relation to the damaging impact of increasing sedimentation in coastal waters, a recent study has found that *benthic light availability was the most limiting factor determining habitat suitability for seagrass in large parts of Adelaide coastal waters. The epiphyte-mediated light limitation was attributable to land-based inputs from effluents from urban wastewater treatment plants but mostly constrained to the nearshore in the north. Wave energy, which causes resuspension of fine sediments in shallow nearshore waters and can uproot plants and seedlings (preventing establishment), limited seagrass habitat suitability in a narrow strip along Adelaide's beaches south of the Port River mouth, while tidal exposure (along with temperature) was limiting in a narrow band in the north, and depth caused light limitation in offshore areas. Habitat suitability was mainly determined by wave climate and light availability as a function of sediment resuspension nearshore and depth-driven CDOM attenuation of light offshore (*Erftemeijer et al, 2023 - Habitat suitability modelling to improve understanding of seagrass loss and recovery and to guide decisions in relation to coastal discharge – paper attached to this submission*).*

The great news is that all efforts are seeing results. Results of a study published in 2022 have found that seagrasses are returning to metro Adelaide coast. Approximately 11,000ha of seagrasses have recovered. Reduction in nutrients discharges and sedimentation have contributed to this success. In particular, the research highlights the impacts of dredging in the Port River region: *the magnitude of seagrass change was not only impacted by thresholds in water quality derived from land-based inputs but further modulated by other cumulative stressors affecting light availability. For example, losses in the central zone were more prominent after the floods in 2005 in comparison to 2016. The differences are likely related to dredging of approximately 3 million m3 of sediments from the shipping channel of the Port River in early 2006. Wind-driven resuspension of this material would have contributed to maintain high turbidity along the coast for at least 1 year after the dredging operation ceased. The impact of the 2006 dredging on seagrass area however was not as pronounced in the north zone probably due to mitigating reductions in WWTP and industrial inputs in the early 2000s supporting seagrass recovery in the nearshore* (SA Water, College of Science and Engineering - Flinders University, School of Biological Sciences - The University of Adelaide, South Australian Environment Protection Authority- Landsat historical records reveal large-scale dynamics and enduring recovery of seagrasses in an impacted seascape – 2022 – paper attached to this submission).

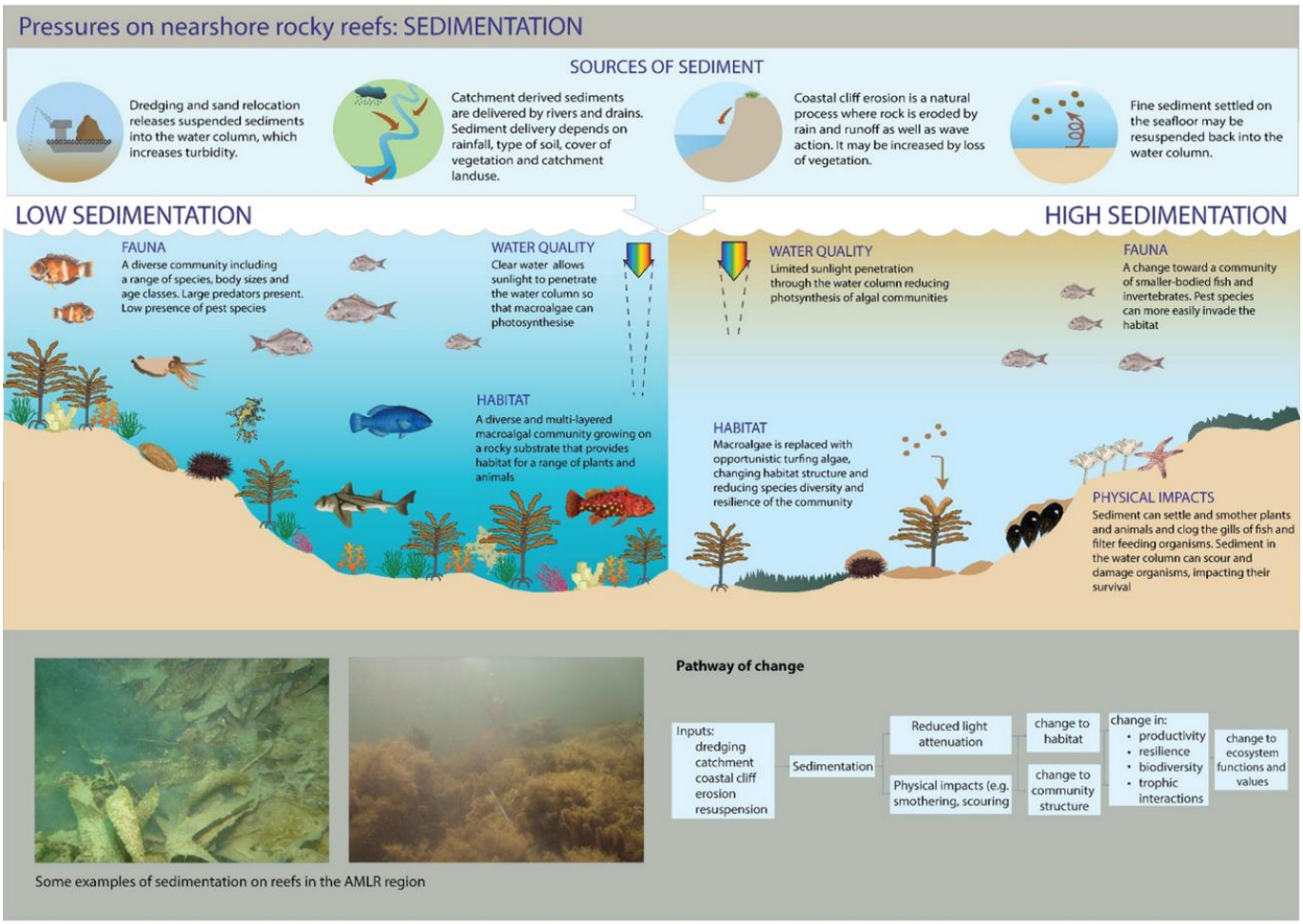
It is concerning that all this effort and money spent during more than 20 years would be at risk if dredging is to be selected as the preferred sand source option, especially because investigations to date have found no suitable sand for beach replenishment.

It is understood that dredging was originally considered as a sand collection method for the sand pipeline at Glenelg as part of the implementation of the Adelaide's Living Beaches Strategy 2005-2025 sand pipeline but was abandoned because of concerns to meet the water quality and odour standards of the EPA at the discharge locations, despite the provision of a ponding swale at Brighton.

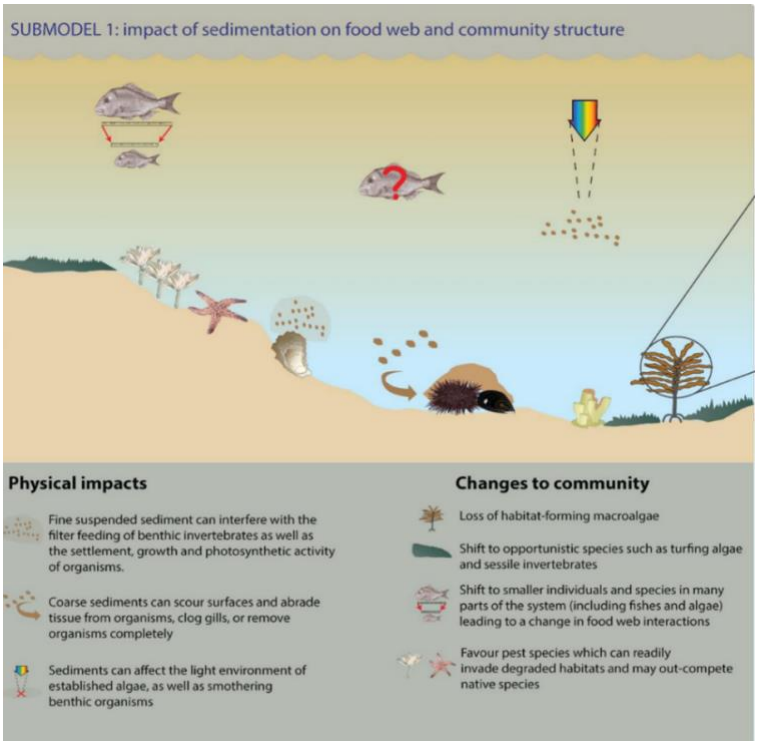
Another concern of dredging in metro Adelaide coast is that dredging creates depressions in the seabed which quickly fill with dead drift seagrass. In turn, when the area is re-dredged, entrainment is exacerbated, further impairing water quality. This is particularly an amenity problem inshore of the sandbars where most swimming occurs, which can lead to environmental nuisance as per Environment Protection Act. Protection of the dredge and discharge pipeline is difficult on the open coastline, as demonstrated at

North Haven where a barge had to be sunk offshore to provide protection. At a Torrens Outlet trial, the pipeline was severely damaged during a one in a ten-year storm. The impacts of turbidity /sedimentation on reefs are also an issue of great concern given the number of reefs found in the metro coast. The impacts would depend on how far the sedimentation plumes would travel to. The following diagrams found in the DEW report *Conceptual models of nearshore reefs in the Adelaide and Mount Lofty Ranges region' 2019 p12 to p15* illustrate the impacts of sedimentation on reefs. Summary of impacts of sedimentation caused by dredging:

- Dredging releases suspended sediment into the water column which makes it cloudier.
- Sediment settles and smoothers marine plants, algae and other marine life.
- Coarse sediment scours and damages plants, algae and kills marine life (clogging gills).
- Sediment on rocky substrate decreases habitat complexity and reduces settlement of marine life.
- Increased turbidity causes less light & photosynthesis which kills seagrass.



Some examples of sedimentation on reefs in the AMLR region



Changes to the marine community caused by dredging sediment include loss of habitat (i.e., kelp and seagrass), reduction in size of fish, and make conditions more favourable to marine pests (which outcompete native species).

Sedimentation impact was observed during the Port Stanvac dredging in the 90s, where a clay layer was dredged causing plumes of sediments that spread along the coast. The plumes with fine sediment caused the total loss of algae that were recruiting at the time, and harm to Noarlunga Reef Aquatic Reserve (and other southern reefs) as documented by Adelaide University who were monitoring the impacts of dredging at the time (refer to reports produced by Anthony Cheshire and Tim Kildea).

Mobilisation of contaminants is also an important impact of dredging that needs to be considered as they may pose a health threat.

The costs of this option and that of dredging must include the costs of ongoing monitoring and loss of ecosystem services as well as the costs for rehabilitation of lost habitats if it turns out that to be the case during dredging and/or after.

There are many reports that describe the threats to marine ecosystems, seagrass loss in metro Adelaide and the health of marine systems, including the State of the Environment Report, that should be consulted. The reports cited in this submission are a small but key sample.

Strongly do not support - **Option 1.2 - Dredge using large offshore sand deposits**

Dredging is not supported due to the potential environmental impacts. Also, this option relies on claims of sand sources, which despite investigations by the Coast Protection Board and others from the 1970s have not revealed any practical deposit apart from the three areas cited, all of which have significant problems. Offshore sources are typically comprised of sediments that are too fine, creating significant risk from dispersed sediment plumes at both the uplift and deposition sites, as well as providing a product that would be highly mobile and would not stay on the beaches, thereby compromising nearshore water quality due to continuous resuspension.

The presence of Holocene muds under offshore sources (particularly at Port Stanvac) create substantial risks once surficial sediments have been removed. Exposure of these mud lenses would result in significant impacts on water quality that would be persistent. Noting that when Port Stanvac was dredged the impacts on reefs (including Noarlunga and Horseshoe Reefs) were caused not only by the sediment plumes from the dredge but also by erosion of an exposed Holocene mud lens; these impacts (from a single dredge event) have taken decades for recovery. Furthermore, dredging the deposit at Port Stanvac is problematic because of the silt entrained in the sand and shallow depth over clay and stones. The last operation using a trailing suction hopper dredge caused a turbidity plume from Maslins Beach to Outer Harbour, triggering an investigation by the EPA concerned about environmental damage to the nearby reef. It also caused considerable community concerns (as mentioned above).

Dredging the deposit at Outer Harbour Section Banks is within an area of high conservation value, with considerable issues. It is understood that the dredging in the Outer Harbour Channel caused sediment plumes affecting nearby seagrass beds.

Dredging offshore of North Haven to Largs Bay is within an area of no known significant sand deposits. Based on past investigations, the sand that is present is shallow (2 metres or less), fine grained with a high carbonate content rendering it uneconomic for beach replenishment because it would drift so much quicker than the native sand. *See Report of the Review of the Management of Adelaide Metropolitan Beaches 1997, Technical Support Information (d) AND p26 section 31, which recommended against the replenishment method.*

Generally, the further offshore one goes the sand becomes finer. Also, the offshore sand has a higher carbonate content. Fine sand and carbonate material are consequently unsuitable for beach replenishment because they drift up to four times faster than the native sand.

Strongly do not support - **Option 1.3 - Combination of dredging offshore deposits and trucking quarry sand**

Dredging is not supported. Also, this is not considered a viable sand collection method as commented on for the Options 1.1 and 1.2. There are no known offshore sand deposits within an economic distance from Adelaide beaches. The concerns over dredging have been explained under option 1.1.

We also do not support the use of quarried sand due to the undiscussed impacts on the source location.

The Mount Compass Quarries alone consume up to 700 ML of fresh Adelaide Hills groundwater (otherwise usable for bottled water, towns water supplies or irrigation). Groundwater Status reports prepared by the previous Department of Environment Water and Natural Resources show declining groundwater levels since 1994 in the Tookayerta Creek Mangement Zone (the area surrounding the mine sites) with increases in groundwater extraction from the Permian Sand aquifer. The declining water level of this aquifer can cause the dewatering of nearby swamps and impact on other groundwater dependant ecosystems.

The mine pits and support infrastructure at Mount Compass currently have a footprint of 152 hectares, the majority of which was native vegetation prior to clearance. The size of the pits grow in direct relationship to the amount of sand extracted, with at least this area again of remnant vegetation within the zone set aside for future sand extraction. These areas of remnant vegetation include small perched swamps, which are the preferred habitat for a disproportionately high number of rare and threatened species, such as the Mount Lofty Ranges Southern Emu-wren. Advocating for increased use of quarry sand would directly contribute to future clearance of these habitats.

Strongly do not support - **Option 2.2 - Pipeline using fixed jet pump systems on jetties**

Investigations for the Sand Pipeline considered extensive trials of available sand collection devices. *See Planning Report for the Sand Transfer Infrastructure Project ALB Appendix D.*

Jet Pumps and other submersible pumps on jetties operate in Queensland (Tweed Heads and Southport) and in high energy coasts where consistent alongshore sand movement and deep sand is found. This system would not work in metro Adelaide because the alongshore drift is not consistent, with most of it occurring during storms. Furthermore, there is a sand overlaying clay with a thin top that, if excavated, would cause sedimentation and turbidity damaging seagrasses apart from not being a reliable source of sand.

It is understood that the systems at Southport and Tweed Heads are for sand bypassing, whereas the system proposed in this Option is for backpassing sand south to counter the littoral drift north. The period of operation suggested in the Option, 3 months, would not be able to access enough sand delivered to the jetty by littoral drift over a year. The depth of sand at Semaphore and Largs Bay is shallow, being 2 metres or less, requiring significant mobility of the pump. Depressions caused by the sand collection would quickly fill with dead drift seagrass creating further contamination of subsequent dredging operations. The use of a macerator on the pump would increase water quality impairment. Marine Industries used a pump equipped with a macerator on a crane to lay a pipeline at Christies Beach and significant clogging of the pump occurred. This option would require a storage of sand equal to a year's littoral drift perhaps in an excavated sump, but not without the problem of dead drift seagrass.

Strongly do not support - **Option 2.3 - Pipeline using a temporary dredge**

Dredging not supported. This option has the same disadvantages as discussed for Option 1.1.

Strongly do not support - **Option 3 - Trucking sand from beaches and quarries**

This option has been unpopular due to trucks moving on beaches and roads, risk associated with safety issues, road damage and traffic congestion. Trucks and associated machinery rely on diesel and this process is more fossil fuel intensive than established pipelines. The recycling sand via pipeline has reduced the number of trucks needed, which is welcomed. If forced to choose between dredging offshore for sand and moving sand by trucks from these sources, this option is the lesser of two evils.

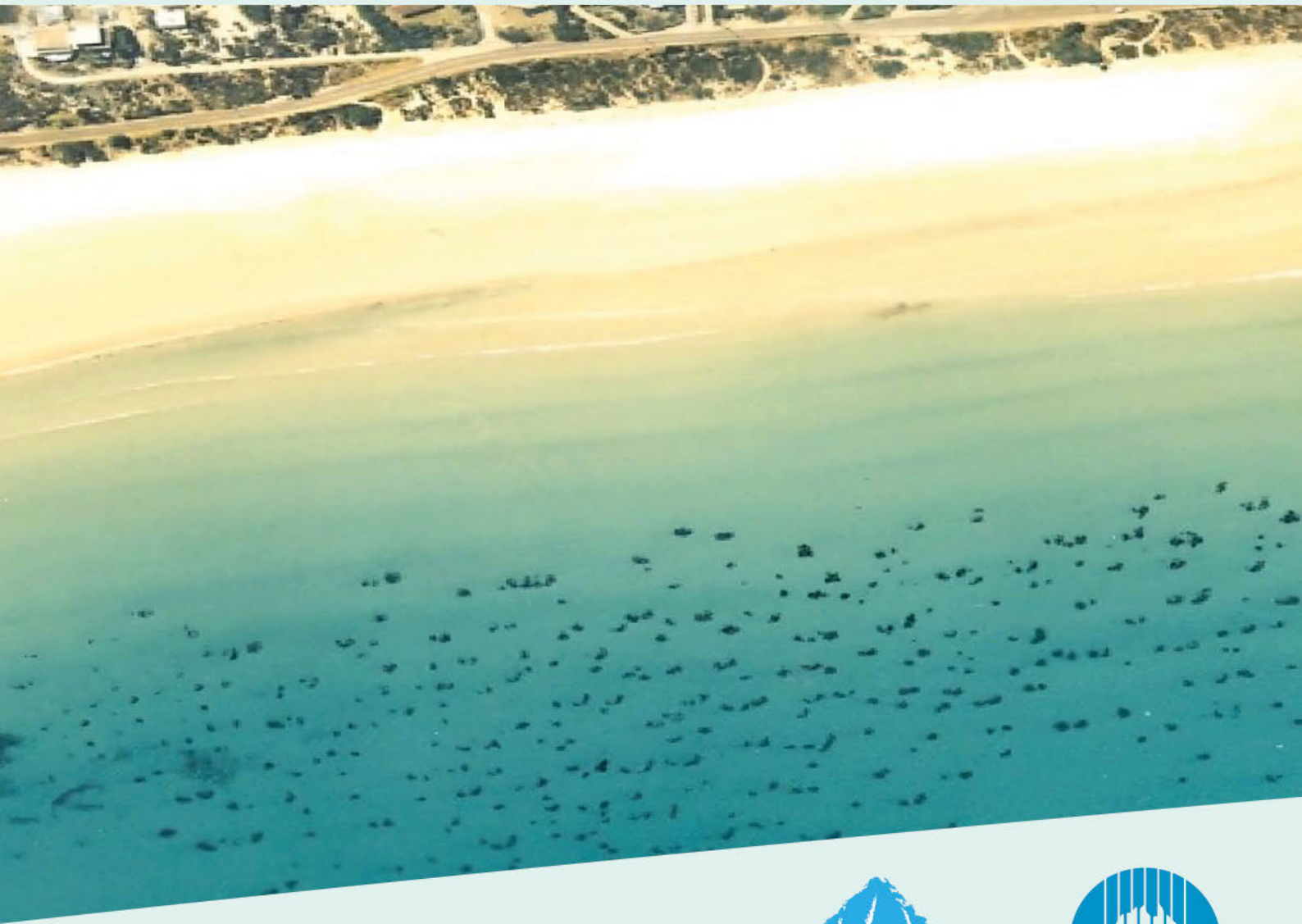
Use of additional quarry sand is not supported unless a source of quarry sand can be found that does not have the source-site impacts (current and future) of the Mount Compass supply.

Examples of what is at risk - Images taken off West Beach between 2021-2023



The Adelaide Coastal Waters Study

Final Report, Volume 1
Summary of Study Findings
November 2007



Adelaide Coastal Waters Study

CSIRO

Prepared for

South Australian Environment Protection Authority

Authors

Fox, D.R., Batley, G.E., Blackburn, D., Bone, Y., Bryars, S., Cheshire, A., Collings, G., Ellis, D., Fairweather, P., Fallowfield, H., Harris, G., Henderson, B., Kämpf, J., Nayar, S., Pattiaratchi, C., Petrusevics, P., Townsend, M., Westphalen, G., Wilkinson, J.

Enquires should be addressed to:

[redacted]

© CSIRO, 2007

ISBN 1 921125 20 9

Limitations and Disclaimer

The sole purpose of this report and the associated services performed by CSIRO and its subcontractors is to provide scientific knowledge about Adelaide's coastal marine environment in support of on-going and future management. Research work was carried out in accordance with the scope of services identified in the head agreement dated 14th October 2002, between the South Australian Minister for Environment and Conservation ('the Client') and the Commonwealth Scientific and Industrial Research Organisation (CSIRO). Under this agreement, CSIRO's role was to devise and oversee a program of research to be undertaken by a number of individuals and organisations.

The findings and recommendations presented in this report are derived primarily from information and data supplied to CSIRO by the Client and from the field investigations and research conducted by sub consultants. The passage of time, manifestation of latent conditions, or impacts of future events may require further exploration and subsequent data analysis, or re-evaluation of the findings, observations, conclusions, and recommendations expressed in this report.

This report has been prepared on behalf of and for the exclusive use of the Client, and is subject to and issued in connection with the provisions of the agreement between CSIRO and the Client. CSIRO accepts no liability or responsibility whatsoever for or in respect of any use of or reliance upon this report by any third party.

FOREWORD

I am pleased to present the Final Report of the Adelaide Coastal Waters Study.

In 2001, the Government of South Australia announced that the Environment Protection Authority (EPA) would manage the Study which sought to develop the understanding needed to redress the issues of seagrass loss, seafloor instability and poor water quality along Adelaide's metropolitan coast. This important work has delivered the ability to establish the targets that need to be achieved to manage our coast in a sustainable manner.

The Final Report of the ACWS integrates a large amount of knowledge derived through the Study, most of it delivered through local areas of expertise - original work that discovered important relationships between Adelaide's coastal ecosystem and its range of inputs. The report is underpinned by 20 Technical Reports, published during the course of the study and a Volume 2 report that summarises much of this work.

We established a partnership with CSIRO to ensure that the science associated with the study was rigorous and well focussed. I am indebted to Professor David Fox who directed the study and David Ellis who managed the project for CSIRO. The quality of the work reflects their skill and perseverance and that of the scientific team whose work underpins this study.

The ACWS Steering Committee, Technical Review Group and EPA officers including a former EPA employee, Dr John Cugley, put considerable time and effort into the guidance of this study, ensuring that the focus remained on developing a body of high quality knowledge about the key issues.

The findings of the report represent a challenge to all South Australians – but we always knew it would, and the different stakeholders have been getting on with implementing this new knowledge as the story began to unfold through the publishing of the technical reports and discussion about findings as they came to light. Even so, the sustainable management of Adelaide's coast and its range of contaminant inputs will take some time to achieve.

While it is crucial that the State Government takes a lead role in providing direction for the sustainable management of our coastal waters, it is equally important for the whole community to recognise that, collectively and individually, we all have a role to play. We must all take responsibility for Adelaide's coast and for its condition when future generations take over their management.

I encourage government, business and industry, peak bodies, academic and research institutions, community groups and individuals to consider and develop actions addressing the findings and suggested responses in this report. Through collaborative efforts we can generate positive change for a sustainable and valued coastal environment along Adelaide.

Dr Paul Vogel
CHIEF EXECUTIVE
Environment Protection Authority

ACKNOWLEDGMENTS

This report draws from and synthesises the results of a number of scientific investigations undertaken during 2003–2005 that defined the Adelaide Coastal Waters Study. We are indebted to the critical role played by our own Scientific Committee and the Client's independent Technical Review Group in ensuring the scientific integrity of the study and of its outputs.

This study could not have been undertaken without the significant contributions made by the researchers listed below who were part of the ACWS scientific research program. The dedication and commitment at both an individual and organisational level to the delivery of quality scientific outcomes is reflected in the pages of the ACWS task reports (listed below).

We are indebted to Alan Butler and his team at CSIRO Marine and Atmospheric Research who undertook the preliminary scoping study that provided invaluable background material and helped identify the research requirements of the present study. The ACWS Steering Committee provided valuable input throughout the study. Their contributions at all stages of the project were greatly appreciated.

We are most appreciative of the resources committed by the study Stakeholders to enable this study to proceed:

- South Australian Environment Protection Authority
- SA Water Corporation
- Torrens Patawalonga and Onkaparinga Catchment Water Management Boards
- Department for Transport Energy and Infrastructure
- Mobil Refining Australia Pty Ltd
- AGL Torrens Island
- South Australian Coast Protection Board
- Primary Industries and Resources SA (PIRSA)
- Ports Corporation.

Non-funding ACWS Steering Committee members include:

- Conservation Council of SA
- SA Fishing Industry Council Inc
- Local Government Association
- Department of Water Land and Biodiversity Conservation
- Planning SA.

We are particularly appreciative of the assistance provided by the Client's representatives, Dr John Cugley and Mr Peter Pfennig of the South Australian EPA.

ACWS Scientific Committee:

- Dr Graham Harris (Chair)
- Prof. David Fox (Study Director)
- Dr Graeme Batley (CSIRO Land and Water)
- Dr Simon Bryars (SARDI Aquatic Sciences)
- Prof. Anthony Cheshire (Science to Manage Uncertainty Pty Ltd)
- Prof. Howard Fallowfield (Flinders University)
- Prof. Peter Fairweather (Flinders University)
- Prof. Chari Pattiaratchi (The University of Western Australia)
- Dr Murray Townsend (SA Department for Environment and Heritage, Coastal Protection Branch)

Independent Technical Review Group:

- Dr Des Lord (Chair)
- Dr Dennis Steffenson (SA Water)
- Dr Rod Connolly (Griffith University)
- Dr Dean Patterson (WBM Oceananics)
- Mr Doug Fotheringham (SA DEH).

Research Teams:

Stage 2 Research Task	Researcher	Organisation
Ecological Processes (EP 1)	Anthony Cheshire	SARDI Aquatic Sciences
	Simon Bryars	SARDI Aquatic Sciences
	David Miller	SARDI Aquatic Sciences
	Greg Collings	SARDI Aquatic Sciences
	Sasi Nayar	SARDI Aquatic Sciences
	Jodi Lill	SARDI Aquatic Sciences
	Emma O'Loughlin	Adelaide University / SARDI Aquatic Sciences
	Peter Fairweather	Flinders University
	Amanda Gaetjens	Adelaide University
	Milena Fernandes	SARDI Aquatic Sciences
	Jason Tanner	SARDI Aquatic Sciences
	Dennis Gonzalez	Flinders University
	Bronwyn Gillanders	Adelaide University
	Yvette Eglinton	SARDI Aquatic Sciences
	Grant Westphalen	SARDI Aquatic Sciences
	Genevieve Mount	SARDI Aquatic Sciences
	Rachel Wear	SARDI Aquatic Sciences
Input Studies (IS 1)	Howard Fallowfield	Flinders University
	Jeremy Wilkinson	Flinders University
	Meryl Pearce	Flinders University
	Nancy Cromar	Flinders University
	Erick Bestland	Flinders University
	John Hutson	Flinders University
	Corinne Le Gal La Salle	Flinders University
	Craig Simmons	Flinders University
	Lynn Smythe	Flinders University
	Nicholas White	Flinders University
	Julianne James-Smith	SA Department of Water, Land and Biodiversity Conservation
	Nikki Harrington	SA Department of Water, Land and Biodiversity Conservation
	Andrew Love	SA Department of Water, Land and Biodiversity Conservation
	Anthony Smith	CSIRO Land and Water
	Gary Hancock	CSIRO Land and Water
	Sébastien Lamontagne	CSIRO Land and Water
Physical Processes and Modelling (PPM 1)	Yvonne Bone	Adelaide University
	Sally Edwards	Adelaide University
	Elizabeth Campbell	Adelaide University
	Linda Deer	Adelaide University
Physical Processes and Modelling (PPM 2)	Peter Fairweather	Flinders University
	Chari Pattiaratchi	The University of Western Australia, School of Environmental Systems Engineering
	John Newgard	The University of Western Australia, School of Environmental Systems Engineering
	Ben Hollings	The University of Western Australia, School of Environmental Systems Engineering
	Rhys Jones	The University of Western Australia, School of Environmental Systems Engineering
	Peter Petrusevics	Oceanique Perspectives
	Jochen Kaempf	Flinders University, School of Chemistry, Physics and Earth Sciences
Environmental Monitoring Program (EMP 1)	Bronwyn Harch	CSIRO Mathematical and Information Sciences
	Brent Henderson	CSIRO Mathematical and Information Sciences
	Melissa Dobbie	CSIRO Mathematical and Information Sciences
Remote Sensing (RS 1)	David Blackburn	David Blackburn Environmental
	Arnold Dekker	CSIRO Land and Water
	Vittorio Brando	CSIRO Land and Water
	Janet Anstee	CSIRO Land and Water

Adelaide Coastal Waters Study Technical Reports

Many of the researchers and support staff listed above contributed to one or more of the twenty ACWS Stage 2 Technical Reports prepared between 2005 and 2007. These technical reports are detailed below. Copies are available at http://www.clw.csiro.au/acws.

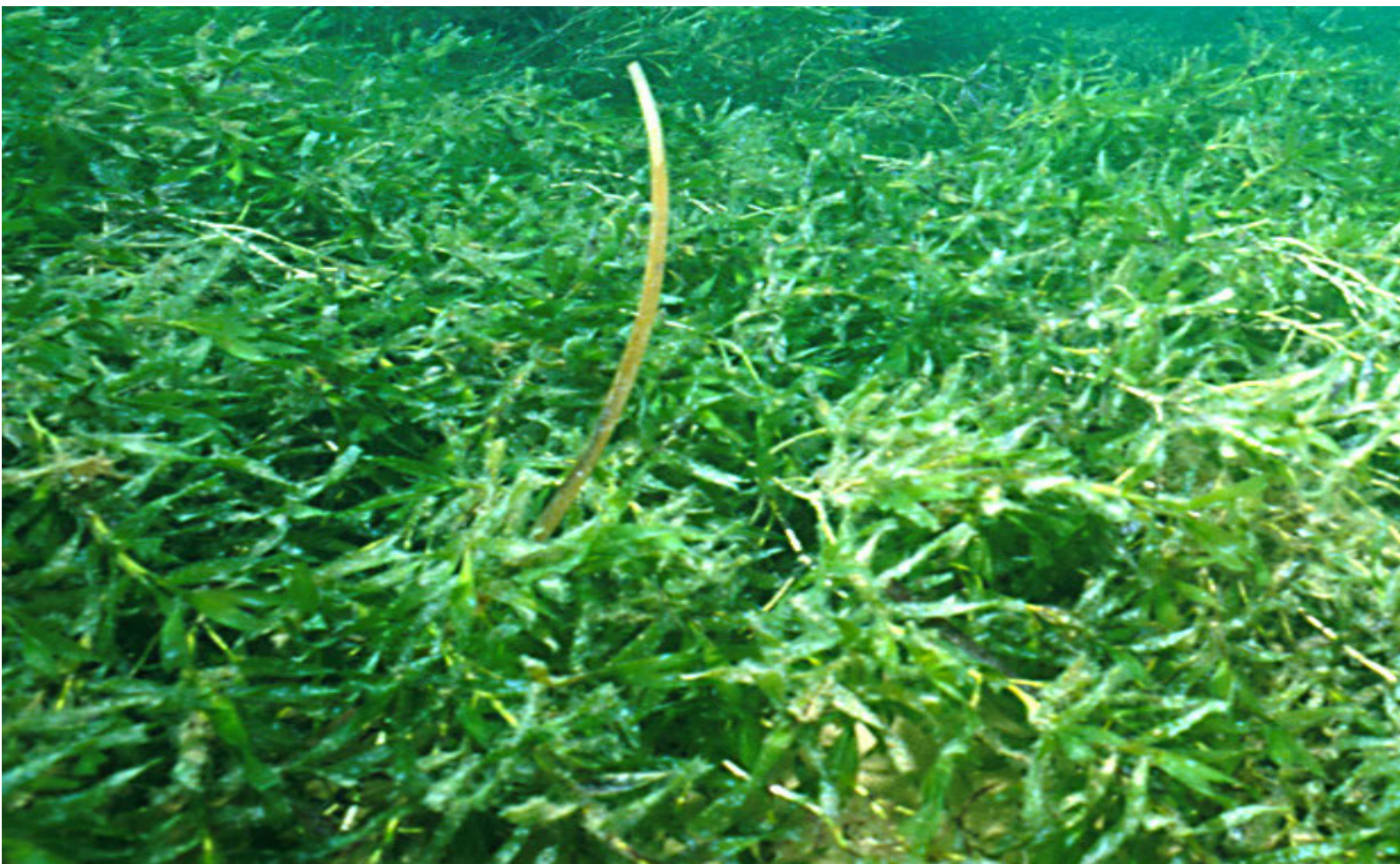
Report No.	Reference
ACWS TR 1	Wilkinson, J., Pearce, M., Cromar, N. and Fallowfield, H. (2003). *Audit of the quality and quantity of effluent discharging from Wastewater Treatment Plants (WWTPs) to the marine environment.* ACWS Technical Report No.1 prepared for the Adelaide Coastal Waters Study Steering Committee, November 2003. Department of Environmental Health, Flinders University of South Australia.
ACWS TR 2	Westphalen, G., Collings, G., Wear, R., Fernandes, M., Bryars, S. and Cheshire, A. (2004) *A review of seagrass loss on the Adelaide metropolitan coastline.* ACWS Technical Report No. 2 prepared for the Adelaide Coastal Waters Study Steering Committee. South Australian Research and Development Institute (Aquatic Sciences), Publication No. RD04/0073, Adelaide.
ACWS TR 3	Wilkinson, J., Hutson, J., Bestland, E. and Fallowfield, H. (2004). *Audit of contemporary and historical quality and quantity data of stormwater discharging into the marine environment, and field work programme.* ACWS Technical Report No. 3 prepared for the Adelaide Coastal Waters Study Steering Committee, June 2004. Department of Environmental Health, Flinders University of South Australia.
ACWS TR 4	Lamontagne. S., Le Gal La Salle, C., Simmons, C., James-Smith, J., Harrington, N., Love, A., Smith, A., Hancock, G., and Fallowfield, H. (2004). *Estimation of groundwater and groundwater N discharge to the Adelaide Coastal Waters Study area.* ACWS Technical Report No. 4 prepared for the Adelaide Coastal Waters Study Steering Committee. CSIRO Land and Water and Flinders University of South Australia, December 2004.
ACWS TR 5	Petrusevics, P. (2005). *Distribution of Suspended Matter in Adelaide Metropolitan Waters Using SeaWiFS Data - Final Technical Report.* ACWS Technical Report No. 5 prepared for the Adelaide Coastal Waters Study Steering Committee. Oceanique Perspectives, January 2005.
ACWS TR 6	Blackburn, D. T., and Dekker, A. G. (2006). *Remote sensing study of marine and coastal features and interpretation of changes in relation to natural and anthropogenic processes. Final Technical Report.* ACWS Technical Report No. 6 prepared for the Adelaide Coastal Waters Study Steering Committee, May 2005. David Blackburn Environmental Pty Ltd.
ACWS TR 7	Kaempf, J. (2005). *In-situ field measurements for Adelaide Coastal Waters Study.* ACWS Technical Report No. 7 prepared for the ACWS Steering Committee, July 2005. School of Chemistry, Physics and Earth Sciences, Flinders University.
ACWS TR 8	Pattiaratchi C. and Jones, R. (2005). *Physical and oceanographic studies of Adelaide coastal waters using high resolution modelling, in-situ observations and satellite techniques - PPM 2 Sub Task 4 Final Technical Report.* ACWS Technical Report No. 8 prepared for the Adelaide Coastal Waters Study Steering Committee. Centre for Water Research, University of Western Australia, Nedlands WA 6907, July 2005.
ACWS TR 9	Westphalen, G., Oloughlin, E., Collings, G., Tanner, J., Elington, Y. and Bryars, S. (2005). *Responses to reduced salinities of the meadow forming seagrasses* Amphibolis *and* Posidonia *for the Adelaide metropolitan coast.* ACWS Technical Report No. 9 prepared for the Adelaide Coastal Waters Study Steering Committee. South Australian Research and Development Institute (Aquatic sciences) Publication No. RD01/02814, Adelaide.
ACWS TR 10	Wilkinson, J. (2005). *Reconstruction of historical stormwater flows in the Adelaide metropolitan area.* ACWS Technical Report No. 10 prepared for the Adelaide Coastal Waters Study Steering Committee, September 2005. Department of Environmental Health, Flinders University of SA.

ACWS TR 11	Collings, G., Bryars, S., Nayar, S., Miller, D., Lill, J. and O'Loughlin, E. (2006). *Elevated nutrient responses of the meadow forming seagrasses,* Amphibolis *and* Posidonia, *from the Adelaide metropolitan coastline.* ACWS Technical Report No. 11 prepared for the Adelaide Coastal Waters Study Steering Committee. South Australian Research and Development Institute (Aquatic Sciences) Publication No. RD01/0208-16, Adelaide.
ACWS TR 12	Collings, G., Miller, D., O'Loughlin, E., Cheshire, A. and Bryars, S. (2006). *Turbidity and reduced light responses of the meadow forming seagrasses* Amphibolis *and* Posidonia, *from the Adelaide metropolitan coastline.* ACWS Technical Report No. 12 prepared for the Adelaide Coastal Waters Study Steering Committee. South Australian Research and Development Institute (Aquatic Sciences) Publication No. RD01/0208-17, Adelaide.
ACWS TR 13	Nayar, S., Collings, G., Miller, D. and Bryars, S. (2006). *Nutrient fluxes in the meadow forming seagrasses* Posidonia *and* Amphibolis *from the Adelaide metropolitan coast.* ACWS Technical Report No. 13 prepared for the Adelaide Coastal Waters Study Steering Committee. South Australian Research and Development Institute (Aquatic Sciences) Publication No. **RD01/0208-18, Adelaide.**
ACWS TR 14	Bryars, S., Miller, D., Collings, G., Fernandes, M., Mount, G. and Wear, R. (2006). *Field surveys 2003-2005: Assessment of the quality of Adelaide's coastal waters, sediments and seagrasses.* ACWS Technical Report No. 14 prepared for the Adelaide Coastal Waters Study Steering Committee. South Australian Research and Development Institute (Aquatic Sciences) Publication No. RD01/0208-15, Adelaide.
ACWS TR 15	Bryars, S., Collings, G., Nayar, S., Westphalen, G., Miller, D., O'Loughlin, E., Fernandes, M., Mount, G., Tanner, J., Wear, R., Eglinton, Y. and Cheshire, A. (2006). *Assessment of the effects of inputs to the Adelaide coastal waters on the meadow forming seagrasses,* Amphibolis *and* Posidonia. *Task EP 1 Final Technical Report.* ACWS Technical Report No. 15 prepared for the Adelaide Coastal Waters Study Steering Committee. South Australian Research and Development Institute (Aquatic Sciences) Publication No. RD01/0208-19, Adelaide.
ACWS TR 16	Bone, Y., Deer, L, Edwards, S. A. and Campbell, E. (2006). *Adelaide Coastal Waters Study - Sediment Budget.* ACWS Technical Report No. 16 prepared for the Adelaide Coastal Waters Study Steering Committee, August 2006. School of Earth and Environmental Science, Discipline of Geology, The University of Adelaide.
ACWS TR 17	Wilkinson, J., Bestland, E., Smyth, L. and White, N. (2006). *The loads of particulate matter and atmospheric nitrogen deposited from wet and dryfall to Adelaide metropolitan coastal waters.* ACWS Technical Report No. 17 prepared for the Adelaide Coastal Waters Study Steering Committee, March 2006. Flinders University of South Australia.
ACWS TR 18	Wilkinson J., White, N., Smythe, L., Hutson, J., Bestland, E., Simmons, C., Lamontagne, S. and Fallowfield, H. (2005). *Volumes of inputs, their concentrations and loads received by Adelaide metropolitan coastal waters.* ACWS Technical Report No. 18 prepared for the Adelaide Coastal Waters Study Steering Committee, September 2005. Flinders Centre for Coastal and Catchment Environments, Flinders University of SA.
ACWS TR 19	Henderson, B., Dobbie, M. and Harch, B. (2006). *An integrated environmental monitoring program for Adelaide's Coastal Waters.* ACWS Technical Report No. 19 prepared for the Adelaide Coastal Waters Study Steering Committee. CSIRO Mathematical and Information Sciences Technical Report No. 05/154, Canberra.
ACWS TR 20	Pattiaratchi, C., Newgard, J. and Hollings, B. (2006). *Physical oceanographic studies of Adelaide coastal waters using high resolution modelling, in-situ observations and satellite techniques - Sub Task 2 Final Technical Report.* ACWS Technical Report No. 20 prepared for the Adelaide Coastal Waters Study Steering Committee. School of Environmental Systems Engineering, University of Western Australia.

We are thankful to the following organisations that provided background data:

- SA Water
- Climate Services Section of the Australian Bureau of Meteorology
- Department of Water, Land and Biodiversity Conservation
- Department for Environment and Heritage.

Finally, we wish to acknowledge the contributions of numerous support and scientific staff without whose help and dedication research projects such as this would never happen. In particular: Rob Molloy (formerly at CSIRO, now SKM), Peter Edwards, Mike Mellow, John Dighton, and John Carragher (Flinders University); Bruce Miller-Smith, Keith Rowling, Mandee Theil, Phillipa Wilson, Maylene Loo, Suzanne Bennett, David Turner, Jason Nicol and Mark Barrett, Sonja Venema, Kylie Johnson, and Stephanie Seddon (SARDI); John Terlot, John Stanley, Ric Daniel, Siobhan George, and Bronwyn Gillanders (Adelaide University); Steve Marvanek, Jane Gillooly, and Stuart McClure (CSIRO); Chris Dallimore and Emma Gale (the University of Western Australia); Krzysztof Wienczugow and Jamie Woodward (the Marine and Freshwater Research laboratory, Murdoch University); Tina Hines (Water Studies Centre, Monash University); Nirmala Dinesh (SA Water); Giles Leypoint (at the University of Brussels); Hugh Kirkman and Eva Abal (University of Queensland); Ray Masini (WA Dept of Environment), and Trevor Smith (Divers Delight).





EXECUTIVE SUMMARY AND KEY RECOMMENDATIONS

Over the years, there has been growing concern about the effects of coastal and catchment development on the marine environment near Adelaide. Nutrients and other pollutants are introduced to near-shore waters from urban and rural runoff (particularly in the southern streams), sewage treatment plants, and some industrial sources.

Environment management agencies, including the South Australian EPA and the Coastal Protection Branch of the Department for Environment and Heritage, have undertaken monitoring activities to quantify seagrass loss and identify impacts on biological and physical coastal processes (including sand movement). Other stakeholders and coastal communities have also expressed concern about algal blooms, water quality for aesthetic values and recreational contact, environmental health, the status of marine habitats, and biodiversity.

However, our understanding of the processes involved and the interrelationships among them has hitherto been inadequate to underpin a comprehensive management response. In 2001 the South Australian government initiated the Adelaide Coastal Waters Study (ACWS) to redress these knowledge deficiencies and to develop an integrated understanding of the system so as to guide future management actions.

An integrated view of the ecosystem will allow the community and managers to assess ecological priorities in the light of practical, economic, and social objectives; it will help gauge suitable trade-offs while minimising the risk of unintended or irreversible (and possibly costly) damage to other parts of the ecosystem.

Other similar large-scale studies have demonstrated the value in this approach. Examples include the Port Phillip Bay Environmental Study in Victoria, the Perth Coastal Waters Study and the Southern Metropolitan Waters Study in Western Australia, and the Brisbane River and Moreton Bay Wastewater Management Study in Queensland. The ACWS is based on the broad principles of adaptive management, a procedure that seeks to reduce the risk of adverse environmental outcomes by continually refining models, processes, and understanding as new data and evidence is gathered.

This report is one of two volumes and it summarises the main findings and outcomes arising from the 4-year study. The companion Volume 2 provides considerably more detail from each of the six research tasks that comprised the ACWS; further detailed results and discussion can be found in the series of technical reports available for download from www.clw.csiro.au/acws.

ACWS had three focus points: water quality, seagrasses, and sediments. Other ecosystem components such as reefs, mangroves, and fish were outside the terms of reference for this study, as were considerations of impacts on human health and on recreational and aesthetic values. This is not to diminish the importance of these aspects of overall coastal marine health and functioning, but simply reflects the limits of available resources and the need to concentrate on assets at greatest risk.

The ACWS research teams were fortunate in being able to draw upon a significant body of existing data and previous research outcomes on Adelaide's coastal waters, findings that had been acquired over many decades. The primary task, therefore, was to fill gaps in our understanding rather than to start with a blank sheet.

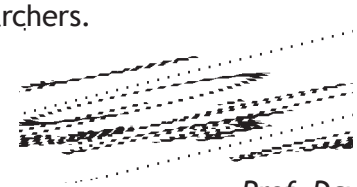
In terms of findings, the ACWS has delivered on its main objectives and in the process it has considerably enhanced our understanding of key processes, stressors, and responses associated with the delicate balance between water quality, seagrass loss, and sediment stability. Consistent with the findings of other similar large-scale studies around Australia's coastline (Port Phillip Bay Environmental Study, Brisbane River and Moreton Bay Study, and Perth Coastal Waters Study), Adelaide's coastal marine environment has undergone significant modification and degradation as a result of many years of near-continuous inputs of nutrient-rich, turbid, and coloured water and wastewater. While these constituents have long been implicated in the loss of seagrasses off Adelaide's metropolitan coast, until now the precise mechanism was poorly understood.

All the evidence points to a key role of nitrogen loads in causing nutrient enrichment of coastal waters, growth of epiphytes, and (perhaps) direct effects on the seagrasses. There is no evidence from this study to show that toxicants or other nutrients play a key role in the ecosystem dynamics. This is totally consistent with the findings of other studies of coastal waters in Australia.

This study has generated a unique historical record of nitrogen (and other) loads to coastal waters, coupled with a long series of observations of seagrass cover in Adelaide coastal waters. Analysis of this historical loading trend (coupled with the realisation there are long time lags in this system between loading increases and seagrass losses) shows that seagrass losses were widespread after the loads increased to about half the present levels.

Sediment movement inshore of the seagrass beds is presently sufficient to prevent regrowth of seagrasses. *Amphibolis* has been shown to recruit to patches of sacking and other rough materials anchored to the bottom – in this way a recruitment source is available to support future recovery if conditions are conducive to recruitment and subsequent growth. Even so, recovery is expected to be slow. In other parts of the world it has taken up to 20 years for seagrasses to regrow once suitable conditions were re-established, and for both *Posidonia* and *Amphibolis*-dominated systems this timeframe may exceed 100 years. Large-scale recovery of seagrass meadows should not be expected unless dramatic and lasting reductions in coastal inputs are made. Even then, sediment instability and nutrient recycling may inhibit progress towards this objective. While evidence of modest (unassisted) recovery in the vicinity of decommissioned sludge outfalls has been noted, it is more likely that that large-scale recovery of seagrass meadows along Adelaide's coast will require intervention, either in the form of provision of appropriate settlement substrate for seedlings, transplanting of mature stock, or the harvesting and planting of germinated seedlings.

In the pages of this report (and the companion technical reports) are detailed the results of years of research, modelling, investigations, and analysis by a dedicated group of scientists. I am confident that their results and understandings will provide an invaluable resource for current managers and future generations of researchers.



Prof. David Fox
Director, Adelaide Coastal Waters Study
November 2007

RECOMMENDATIONS

Recommendation #1

As a matter of priority, steps must be taken to reduce the volumes of wastewater, stormwater, and industrial inputs into Adelaide's coastal environment. This should be done within the context of an overarching strategy designed to remediate and protect the metropolitan coastal ecosystem.

Recommendation #2

The total load of nitrogen discharged to the marine environment should be reduced to around 600 tonnes (representing a 75% reduction from the 2003 value of 2400 tonnes).

Recommendation #3

Commensurate with efforts to reduce the nitrogen load, steps should be taken to progressively reduce the load of particulate matter discharged to the marine environment. A 50% load reduction (from 2003 levels) would be sufficient to maintain adequate light levels above seagrass beds for most of the time. The reduced sediment load will also contribute to improved water quality and aesthetics.

Recommendation #4

To assist in the improvement of the optical qualities of Adelaide's coastal waters, steps should be taken to reduce the amount of CDOM (coloured dissolved organic matter) in waters discharged by rivers, creeks, and stormwater drains.

Recommendation #5

While the available data suggests that toxicant levels in Adelaide's coastal waters pose no significant environmental risk, loads from point sources such as the Port River, WWTPs, and drains should continue to be reduced. Routine monitoring of toxicant loads and concentrations should be undertaken every 3-5 years.

Recommendation #6

Develop and implement a comprehensive and integrated environmental monitoring program that will enable natural resource managers and all Stakeholders to evaluate changes in the coastal marine environment over time and at various spatial scales.

Recommendation #7

Maintain and develop the comprehensive data base of historical inputs generated by this study. It is suggested that a single entity be created to oversee the administrative functions associated with data collection, storage/retrieval, analysis, and reporting. This entity should also assume responsibility for the on-going maintenance and application of the various models produced by the ACWS so as to ensure that they

remain both relevant and accessible. Consideration should also be given to the establishment of a research/monitoring coordination body. A primary function of this body would be to prioritise on-going and future research activities and to seek and allocate funding in accordance with those priorities.

Recommendation #8

Implement a long-term monitoring program to assess seagrass quality (or 'health') at sites adjacent to land-based discharges and at suitable reference sites.

Recommendation #9

Implement a long-term monitoring program of the outer depth margin of Posidonia *meadows in Holdfast Bay.*

Recommendation #10

Implement a long-term monitoring program of seagrass meadow fragmentation at a range of sites in Holdfast Bay.

Recommendation #11

Undertake detailed mapping of the distribution of Amphibolis *across the Adelaide metropolitan area, determine the lower depth limit of seagrasses in Holdfast Bay, and map seagrasses in the southern metropolitan area between Seacliff and Sellicks Beach.*

Recommendation #12

Undertake a spatially intensive nitrogen stable isotope survey to determine the offshore and northern extents of nitrogen influence from WWTP and industrial outfalls along the Adelaide metropolitan coastline, and also characterise nitrogen stable isotope signatures of potential nitrogen sources.

Recommendation #13

Undertake an audit of key environmental assets in the southern metropolitan coastal region; identify risks to those assets and develop an integrated management plan to mitigate the risks. The applicability of management actions developed in response to the findings of this study to halt and reverse ecosystem degradation in the northern regions should be investigated with a view to adopting it (possibly with modification) in the southern region.

Recommendation #14

Adelaide's coastal marine environment must be managed as a component of a system that integrates catchment management, urban and rural land use, demographics, urban and industrial development, climate change/climate variability, and water re-use.

Table of Contents

FOREWORD III

ACKNOWLEDGMENTS IV

EXECUTIVE SUMMARY AND KEY RECOMMENDATIONS IX

RECOMMENDATIONS xii

1 BACKGROUND AND CONTEXT 2

1.1 Historical Context of Adelaide's Coastal Environment 2

2 MANAGEMENT ISSUES AND STUDY OBJECTIVES 3

2.1 Management Issues 3
2.2 Generic Stakeholder Issues 4
2.2.1 Discharges of wastewater and stormwater 5
2.2.2 Water quality: contaminants and toxicants 6
2.2.3 On-going seagrass decline and low levels of re-establishment 6
2.2.4 Sediment instability and dynamics 6
2.2.5 Threats to habitats and ecological processes 7
2.3 Study Objectives 7
2.3.1 Nutrients 8
2.3.2 Other contaminants 8
2.3.3 Stormwater and wastewater inputs 8
2.3.4 Seagrass ecology 8
2.3.5 Physical processes and sediments 9
2.4 Study Region 10
2.5 Study Design 10
2.6 Research Tasks 12

3 RESEARCH OUTCOMES - KEY UNDERSTANDINGS 14

3.1 Physical Processes 24
3.1.1 Nutrient transport 24
3.1.2 Sediment transport 24
3.2 Inputs - Water Quality 25
3.3 Sediments 32
3.3.1 Coastal sediment quality 33
3.4 Seagrasses 33

4 CONCLUSIONS 36

4.1 Physical Processes 38
4.2 Response of the Seagrass-dominated Ecosystems in Coastal Waters 39

5 RECOMMENDATIONS 41

6 DIRECTIONS FOR FUTURE RESEARCH 40

7 MONITORING AND MANAGEMENT 45

7.1 Seagrass Monitoring 45
7.2 Sediment Stability 46
7.3 Terrestrial Inputs 46
7.4 Coastal Water Quality 46
7.5 Physical Processes 46

8 REFERENCES 48

GLOSSARY 49

1 BACKGROUND AND CONTEXT

Over the years, there has been growing concern about the effects of coastal and catchment development on the marine environment near Adelaide. Nutrients and other pollutants are introduced to near-shore waters from urban and rural runoff (particularly in the southern streams), sewage treatment plants, and some industrial sources. The historical situation is well known. The retreat of the 'blue line', which marks the near-shore edge of the seagrass beds appears to have commenced in the period between 1935 and 1949 in Holdfast Bay, stimulated perhaps by the first sewage discharges from Glenelg in 1943. The Penrice soda-ash plant at Osborne in the Port River also started operating in 1940. Further losses in the north were associated with the discharge of wastewaters from Bolivar in the late 1960s. The retreat was largely complete by the 1980s. Sludge outfalls which operated between the 1960s and 1993 caused the loss of seagrasses offshore. The greatest rate of loss of seagrasses occurred in the early 1970s, about 8 years after the maximum rate of population growth in the metropolitan region. In recent years the rate of seagrass loss appears to have slowed, with some re-colonisation occurring in the areas of loss around the old sludge outfalls. There has, however, been no re-colonisation inside the 'blue line' along the beaches and fragmentation of the seagrass meadows in central and southern Holdfast Bay continues.

1.1 Historical Context of Adelaide's Coastal Environment

Prior to European settlement, Adelaide's coastal waters were pristine. The pattern of catchment outflows in the Adelaide region was dominated by winter runoff, which was largely assimilated by the swamps and marshes behind the coastal dunes. Outflows from the Port Adelaide River (hereafter referred to as the Port River) would have been infrequent. Loads of nutrients and turbidity to coastal waters would have been small as a result and, because they would have been dominated by runoff from native bush, the flows would have been characteristically high in coloured organic material and low in turbidity and available nutrients. The impact of these loads on coastal waters would have been small and intermittent, leaving largely intact marine ecosystems abutting the land. Water quality in the near-shore zone would have been similar to that found in the rest of the Gulf. Seagrasses (most notably *Amphibolis* and *Posidonia*) were presumably abundant in shallow waters along the coast, and these not only stabilised the sediments but were a source of new, calcareous material (from decaying marine organisms found within the seagrass meadows).

Coastal swamps were drained and filled in the mid 1950s and an efficient network of storm drains established. The completion of the concrete lining of the suburban Sturt River channel effectively replaced an efficient stormwater detention and settlement system (that discharged at a low and steady rate) with a rapid-transit system delivering large 'parcels' of turbid freshwater to the coastal zone after each significant rainfall event. In addition to the Sturt River and Brownhill and Keswick Creeks, the Patawalonga system includes the airport drain. Until recently the Patawalonga system drained through the Patawalonga flood gates. The Patawalonga Lake acted as a settling pond for stormwaters — it has been estimated that the Lake removed around 43% of suspended solids. In the early 1970s recreational activity in the lake was banned due to faecal contamination and the lake bed was dredged and the contaminated material land-filled on the airport site.

In 2001, the Barcoo Outlet was constructed. This is a siphonic system that, starting at the upstream end of the lake, diverts flow underneath the beach to a discharge point a few tens of metres off shore. Flow into the Patawalonga Lake is

controlled by sluices which release water into the lake when the capacity of the Barcoo Outlet to drain is exceeded. This system bypasses the Patawalonga Lake, effectively short-circuiting contaminated storm flow from the Sturt River, Brownhill Creek, and the airport drain directly to the coastal zone without the beneficial settlement afforded by Patawalonga Lake.

The cumulative impacts of over 60 years of continuous and episodic land-based inputs have resulted in a significantly degraded coastal environment. The loss of over 5000 ha of seagrass is of particular concern, given the scale and significance of both direct and indirect effects. Direct effects include loss of biological diversity and changes to the biological, chemical, and physical benthic habitat. In Adelaide, a secondary effect of seagrass loss has been the increased instability of the seafloor, resulting in the mobilisation and transport of sediments along the coast. Large deposits of fine-grained sand, previously trapped within seagrass meadows, now accumulate in sandbars close to shore.

2 MANAGEMENT ISSUES AND STUDY OBJECTIVES

Over the years, there has been growing concern about the effects of coastal and catchment development on Adelaide's marine environment. Nutrients and other pollutants are introduced to near-shore waters from urban and rural runoff (particularly in the southern streams), sewage treatment plants, and some industrial sources. At the same time, environment management agencies, including the South Australian EPA and the Coastal Protection Branch of DEH, have undertaken monitoring activities to quantify seagrass loss and identify impacts on biological and physical coastal processes (including sand movement). In 2000, the Department for Environment and Heritage initiated a review of the management of Adelaide's metropolitan beaches. The outcome of this review was the development of a 20-year management strategy for Adelaide's beaches. The cornerstone of this strategy was a combination of approaches, including sand recycling, engineering structures, and importing coarse sand from external sources. Dredging and sand bypassing are also undertaken along the metropolitan coast to maintain channel depths and enable sand to continue to drift northward. More recently, however, the effectiveness and social impacts of these management strategies has been questioned, and new techniques for beach replenishment — such as pumping sand through pipes — have recently been trialled.

Other stakeholders and coastal communities have expressed concern about a variety of other issues such as algal blooms, water quality for aesthetic values and recreational contact, environmental health, and the status of marine habitats and biodiversity. However, until now our understanding of the processes involved and the interrelationships among them has been inadequate to underpin a comprehensive management response.

2.1 Management Issues

There is a long list of issues that have acted as drivers for the ACWS, and although many of these were obvious candidates (e.g. the impact of high sediment and nutrient loads), other, more subtle, issues (e.g. the role of epiphytes on seagrass decline) required more careful elicitation. Stage 1 of ACWS was devoted to the identification and documentation of an extensive, although not necessarily exhaustive, list of stakeholder issues and concerns.



a



b

Figure 1: The Edwards Street Drain in Brighton discharging turbid storm runoff in (a) 1974 and (b) a more coloured foaming discharge in 2004. (Note: foaming commonly results from the breakdown of organic matter such as leaf debris.) *Photo a: from Lewis S. A. (1975); Photo b: J. Wilkinson*

2.2 Generic Stakeholder Issues

The complete list of stakeholder issues can be found in Volume 2 of this report or the consolidated research plans[1]. The generic issues are captured by the following questions:

- What is the fate of nutrients (N and P) and what are their respective impacts on the receiving marine environment and ecosystem functions?
- What are the relative contributions of all contaminant inputs?
- Are there any other parameters of concern in the coastal waters in addition to or instead of nutrients?
- What is the pollution load entering the coastal zone from all sources?
- Is it pollution load or concentration that is important in water quality management?
- What impact do low-salinity discharges have on seagrass communities and different species within communities?
- What is the cumulative impact on seagrass health of low-salinity and high-turbidity discharges from the various coastal stormwater outlets?
- Why have we lost and continue to lose the near-shore seagrass?
- Is seagrass loss due to freshwater inputs, nutrients, increased turbidity, other pollutants and other effects including coastal processes - or a combination of all of these?

[1] Available at http://www.clw.csiro.au/acws/documents/Final_ACWS_Consolidated_Research_Plan_Aug04.pdf

- Is seagrass loss progressive or episodic (e.g. driven by storm events or high stormwater discharge)?
- Are there other indicators of marine environment disturbance in addition to seagrass decline?

The predominant themes to emerge from the generic issues are discussed in the following sections.

2.2.1 Discharges of wastewater and stormwater

Coastal degradation caused by wastewater and stormwater discharges became apparent from the late 1940s. During the 1970s, a peak period of degradation occurred that mirrored significant increases in development, population, and discharges. Prior to the 1930s, there were relatively few inputs to the coastal zone. However engineering projects - such as the diversion of the Torrens River, the construction of numerous stormwater drains, the lining of Sturt River, and the Barcoo outlet - significantly increased the volume of turbid, highly coloured, nutrient-enriched waters delivered to coastal waters. During the same period, new wastewater treatment plants (WWTPs) were commissioned and these added to the loads of sediments, nutrients, 'fresh' water, and other contaminants into the marine environment. In addition, between 1961 and 1993, sludge material from the Glenelg and Port Adelaide facilities was piped off-shore and allowed to disperse and settle under the action of currents, tides, and other physical processes. There is also anecdotal evidence to suggest that occasionally the sludge pipes ruptured fairly close to shore, although the frequency and duration of such events is not documented.



Figure 2: Major discharge of stormwater from the Torrens River into Adelaide's coastal waters on 25 October 2005. Dark region is increased turbidity. *Photo: S. Bryars*

2.2.2 Water quality: contaminants and toxicants

In addition to increased sediment and nutrient loads, there are many other indicators of general water quality. Physical parameters such as temperature, salinity, light, and dissolved oxygen are usually most relevant to biotic functioning and integrity, while anthropogenic contaminants such as heavy metals, pesticides, herbicides, organochlorines, and hydrocarbons can pose significant risks to human and marine life. Other similar studies around the Australian coast have detected the presence of such contaminants, although generally at levels that pose no significantly increased risk. Previous studies of pollution levels in the Port River identified moderate to high turbidity; high levels of PCBs, lead, zinc, and copper; and high ammonia and chlorophyll-a concentrations. There have been a limited number of studies of similar scope and intensity in the near-shore coastal region.

2.2.3 On-going seagrass decline and low levels of re-establishment

The loss of large tracts of (*Posidonia*) seagrass is one of the most visible and significant impacts on Adelaide's coastal environment. Seagrasses provide a natural habitat for many species of marine life and they stabilise the underlying sediments. Any loss will clearly negatively impact on these functions and may also increase the risk of colonisation by exotic marine pests.

Migrating sand patches within seagrass meadows, coupled with anecdotal evidence supported by aerial photos taken in the 1930s, suggest that the 'blue line' (i.e. the inner edge of seagrass meadows) was within 200 m from the shore in Holdfast Bay in the middle of last century, but by 1968 it had regressed hundreds of metres further offshore. During the period 1949 to 1995, some 4000 ha of seagrass was lost between Aldinga and Largs Bay. While the rate of loss since the 1940s has been irregular, the average of 85 ha per year was marked by a substantial peak between 1971 and 1977. During this short period approximately 50% of the total seagrass meadows between Glenelg North and West Beach (using 1949 as a baseline) was lost.

In terms of species, there has been a noticeable trend away from mixed *Posidonia* and *Amphibolis* seagrass communities, with the latter lost in many areas. Minimal re-establishment has been detected in the vicinity of the decommissioned Port Adelaide sludge pipe. The environment improvement plans (EIPs) of the last 10 years have had a pronounced beneficial impact on coastal water quality; however this alone is unlikely to result in successful re-establishment of lost seagrass communities since other, non-nutrient-related factors also contribute to the lack of recolonisation. The role of 'blowouts' (episodic loss of small patches of seagrass) in explaining larger spatial and temporal trends in seagrass loss is not well understood. A particular concern is that Adelaide's seagrass beds may have been fragmented by the expansion of blowouts to such an extent that remnant patches are now vulnerable to lower-intensity (more frequently occurring) storms than would be the case for larger seagrass patches.

2.2.4 Sediment instability and dynamics

As was noted in the previous section, the loss of seagrass has implications for the stability of the underlying sediments. Adelaide's beach replenishment program is tangible evidence that sediment-transport rates are out of equilibrium, with an accumulation to the north and depletion in the south. The South Australian DEH, Coastal Protection Branch, has estimated that sand supply to the active beach zone

has been increased by approximately 100,000 m^3/y due to seagrass losses. This loss of seagrass creates a cycle of further loss through negative effects of increased turbidity and through accession to erosive forces associated with blow outs. Seagrass losses have also modified the bathymetry profiles, with depth increases further impacting on coastal erosion processes.

2.2.5 Threats to habitats and ecological processes

Seagrass loss equates to a loss of local biodiversity. An approximate 40-fold difference exists between biodiversity in seagrass and bare-sand communities. Effluent discharges and increasing sedimentation rates threaten the abundance and diversity of biota on reefs (e.g. the loss of large brown algae on northern reefs). In Barker Inlet, *Ulva* (cabbage weed) growth is smothering mangrove seedlings and its decomposition reduces oxygen availability. The exposure of the clay or calcrete base material (due to seagrass loss and sediment removal) increases the risk of colonisation by exotic pests and the exclusion of native species.

2.3 Study Objectives

The Adelaide coastal ecosystem is unique because of potential large-scale interactions between seagrasses, beach and near-shore morphology, benthic biota, nutrients and toxicants, and water quality. In 2001, the SA government initiated the Adelaide Coastal Waters Study (ACWS) to redress knowledge deficiencies and develop an integrated understanding of the coastal system from which to guide future management actions. An integrated view of the ecosystem will allow the community and managers to assess ecological priorities in the light of practical, economic, and social objectives; it will help gauge suitable trade-offs while minimising the risk of unintended or irreversible (and possibly costly) damage to another part of the ecosystem.

Other similar large-scale studies have demonstrated the value in this approach. Examples include the Port Phillip Bay Environmental Study (PPBES) in Victoria (Harris et al. 1996), the Perth Coastal Waters Study in Western Australia (Lord and Hillman 1995), and the Brisbane River and Moreton Bay Wastewater Management Study in Queensland (Dennison and Abal 1999). The ACWS was based on the broad principles of adaptive management, a procedure that seeks to reduce the risk of adverse environmental outcomes by continually refining models, processes, and understanding as new data and evidence is gathered.

As with any environmental study, there is a need to clearly define the scope so that limited resources are appropriately allocated to addressing the most important issues. After extensive consultation with stakeholders, it was agreed that the Adelaide Coastal Waters Study would focus on:

- seagrass loss
- seabed instability
- water quality degradation.

There are of course numerous other important environmental issues associated with the sustainable management and use of Adelaide's coastal waters (such as mangroves, recreational and commercial fisheries, recreational water quality, beach aesthetics, and so on). That they have not been specifically studied as part of the ACWS is not to diminish their importance but is simply a matter of focus, resources, and risk management.

The main research themes and stakeholder issues which were specifically investigated by the ACWS are identified below.

2.3.1 Nutrients

- Fate of nutrients (nitrogen and phosphorus) and their respective impacts on the receiving marine environment and ecosystem functions;
- Relative contributions (volumes and loads) of contaminant inputs from all sources and the significance of impacts on water quality and the marine ecosystem;
- Target loads for receiving waters.

2.3.2 Other contaminants

- identification of contaminants (other than nitrogen and phosphorus) that are implicated in seagrass loss;
- quantify contaminant loads (other than nitrogen and phosphorus) entering the study region;
- toxicity of contaminants to seagrasses;
- relative impact of Port River inputs.

2.3.3 Stormwater and wastewater inputs

- composition of stormwater;
- fate of stormwater and wastewater contaminants;
- loads of wastewater and stormwater contaminants;
- spatial distribution of stormwater outfalls and association with seagrass loss;
- significance of stormwater/wastewater colour and turbidity for coastal ecosystems;
- effectiveness of government and industry environment improvement plans.

2.3.4 Seagrass ecology

- mechanism for seagrass loss (both initial triggers and on-going decline);
- role of freshwater inputs, nutrients, increased turbidity, and other pollutants, and other effects including coastal processes or a combination of these;
- dynamics of seagrass loss (episodic, continual, blowouts, etc.);
- tolerance of seagrasses to altered conditions (turbidity, light, nutrients, toxicants);
- impact of low salinity levels on seagrass communities (and different species within communities);
- prospects of seagrass recolonisation and conditions which would be conducive to this;
- implications for other coastal and ecological processes if widespread seagrass recovery was attained;
- nutrient sources for seagrass epiphytes.

2.3.5 Physical processes and sediments

- identify and understand the physical processes (winds, tides, currents, temperature, density effects, etc.) that operate on Gulf-wide and local scales;
- sources and sinks for coastal sediments — sedimentary 'budget';
- defining the interplay between sediment transport and seagrass loss;
- defining physical processes that determine fate of sediments and loss of seagrass (e.g. 'scouring', wave attenuation);
- characterising the effect of the Port River system on the Gulf and near-shore coastal waters.

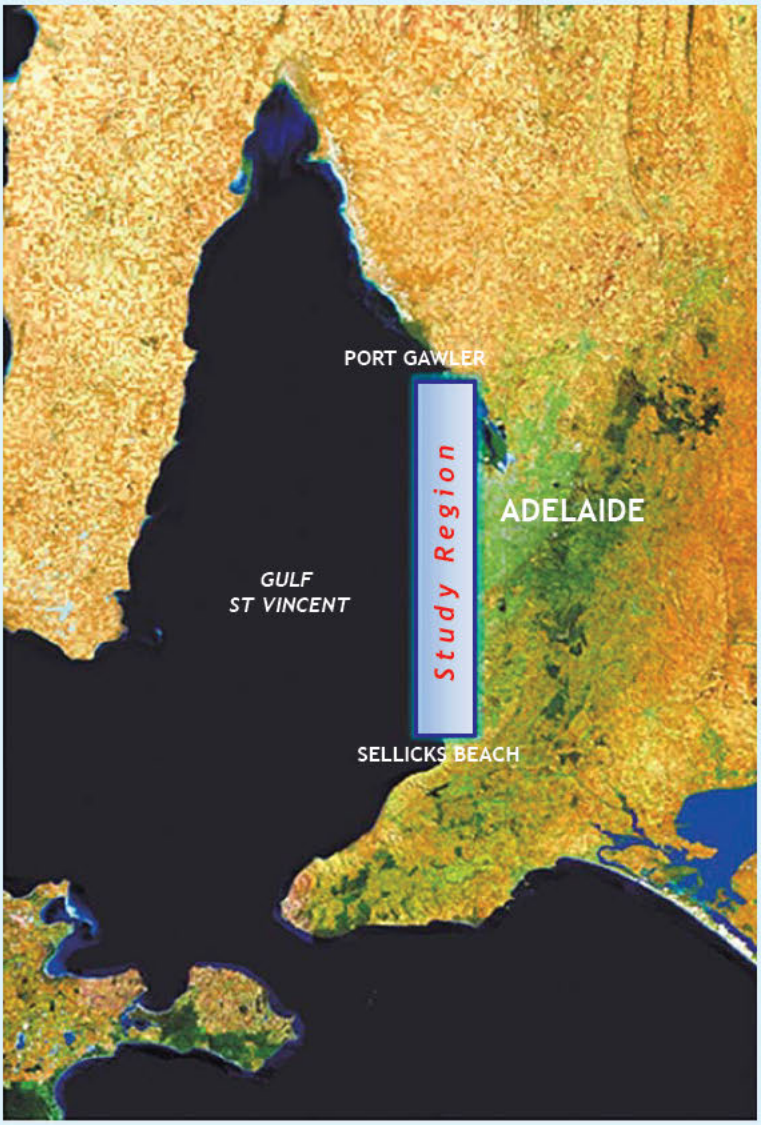


Figure 3. Adelaide Coastal Waters Study region.

2.4 Study Region

The ACWS study area extends along the eastern side of Gulf St Vincent from Port Gawler at the discharge of the Gawler River, to Sellicks Beach in the south (Figure 3). The seaward boundary is nominally 20 km from the high water mark. No landward boundary was defined, but for the purpose of the study it encompasses the catchments of the contributing streams and rivers flowing to and discharging to the coastal waters. Although important, the Port River and associated estuary and wetlands were not a primary focus for the Adelaide Coastal Waters Study. However, the input of nutrients and other contaminants from the Port River to the coastal strip have been quantified and factored into model development and calibration.

As the study progressed it became evident that resolution of most management issues required increasing focus in the near-shore zone (typically out to about a depth of 10 m or 5 km off-shore). Accordingly, four near-shore zones and two off-shore zones were identified based on considerations of land use, physical properties, inflows, and historical developments (Figure 4). A description of the six zones is given in Table 1.

Table 1. ACWS zonation according to terrestrial inputs

Zone	Features
1 (Northern)	Gawler River, Bolivar WWTP, Smith Creek, and all terrestrial discharges physically within the mouth of the Barker Inlet. Seagrass loss associated with the combined impacts of Bolivar and the Barker Inlet discharges.
2 (Central)	All major discharges from Largs Bay to Merino. Near-shore seagrass loss.
3 & 3A (Southern)	All remaining discharges from Marino to Sellicks Creek. Relatively steep shelving with minimal impact.
4 (Central offshore)	Off-shore meadow fragmentation.
5	Port Adelaide sludge outfall zone.

2.5 Study Design

The study was designed around the key components: (i) quantification of inputs (type and load); (ii) a physical model that 'moves' the inputs around in a manner that honours the real system; and (iii) ecological model(s) to predict the response of key ecosystem components (e.g. seagrass) to their immediate environment. The development and constant refinement of a conceptual model informed the study design and assisted in the interpretation of results (Figure 5).

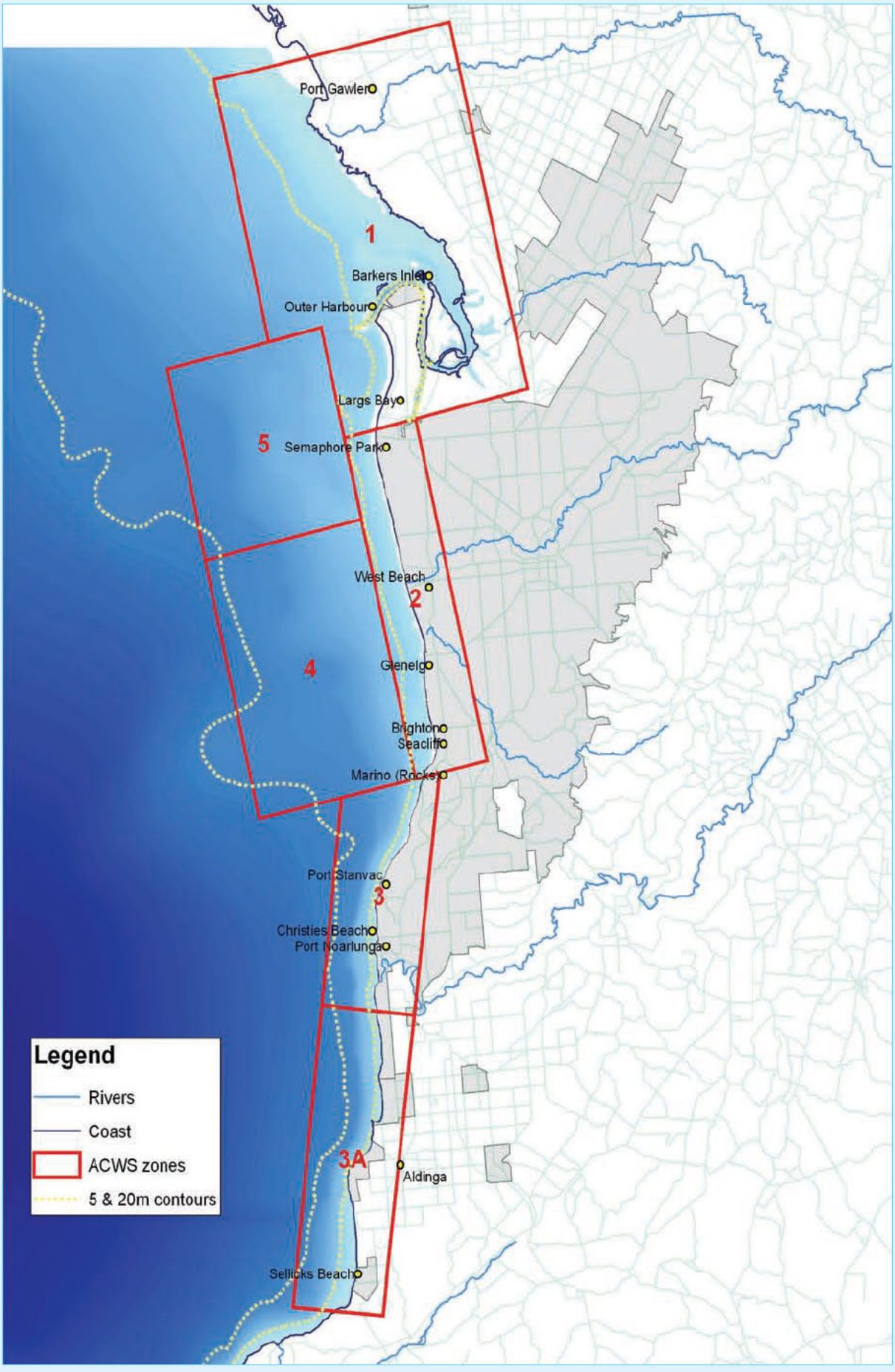


Figure 4. Zones within the Adelaide Coastal Waters Study region.

2.6 Research Tasks

The ACWS research tasks were grouped according to the three main components (i, ii, and iii) mentioned in the previous section. A listing of these tasks and a brief description is given in Table 2. The models in (ii) and (iii) were 'uncoupled' in the sense that the physical (hydrodynamic) model employed by the ACWS did not have an embedded model to simultaneously describe (in space and time) ecological processes. While coupled models are attractive, they can be difficult to calibrate, can be computationally expensive, and have no guarantee of superior performance over less complex approaches. It was for these reasons, together with the fact that the ACWS was focussed on 'macro' issues (for which detailed modelling of biological processes such as epiphyte grazing and plant respiration was not required), that a simpler, uncoupled modelling approach was adopted.

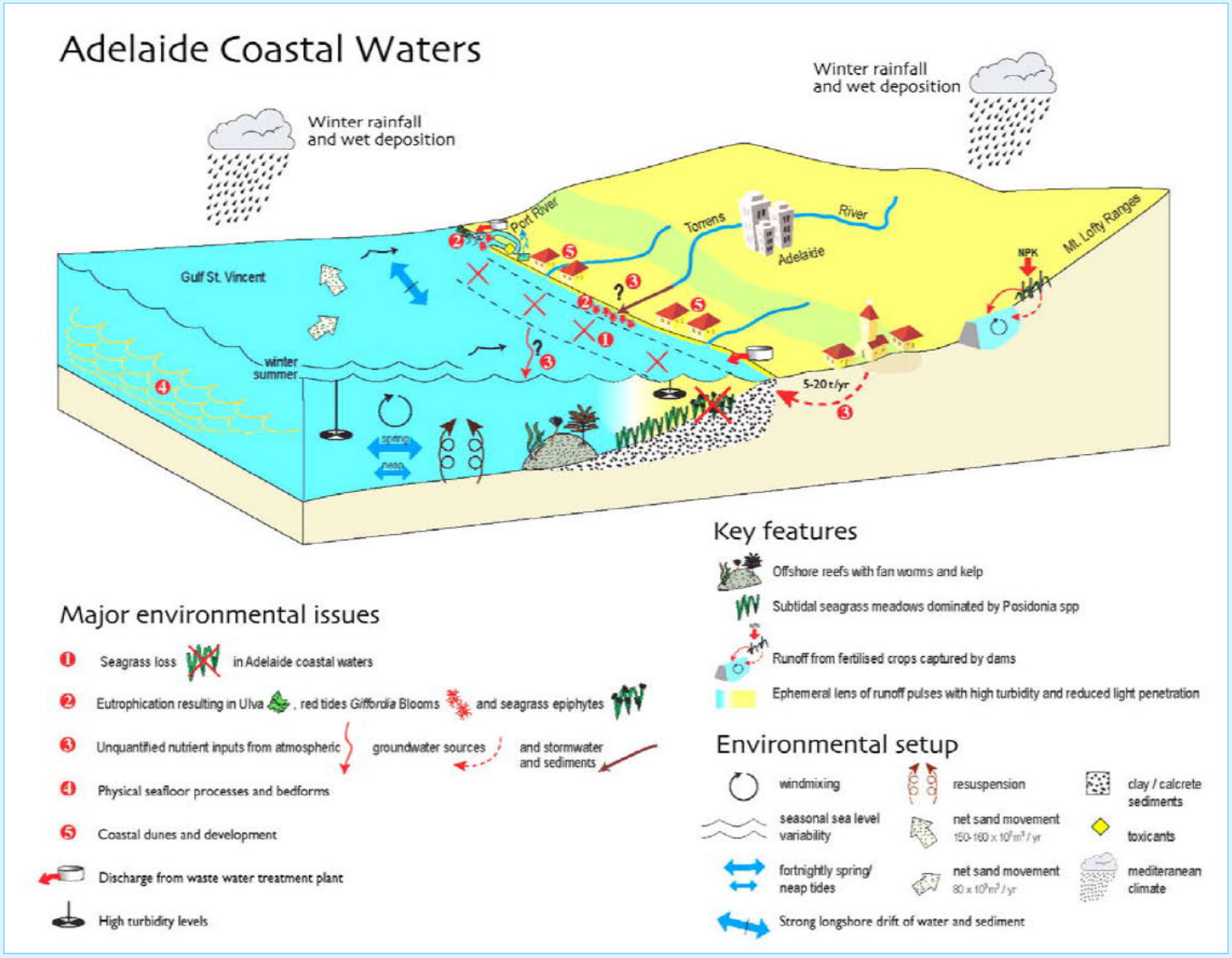


Figure 5. The 2006 ACWS conceptual model

Table 2. Research tasks for the Adelaide Coastal Waters Study

Task code	Research/activity title
Stage 2 Research tasks	
Input studies - quantity and quality	
IS1	Quantification of diffuse and point source terrestrial, groundwater, and atmospheric inputs to the coastal waters
IS 1-SP 1	Stormwater flows from major and minor catchments: audit and monitoring
IS 1-SP 2	Audit of the quality and quantity of effluent discharging from WWTPs to the marine environment
IS 1-SP 3	Groundwater discharge to the coastal environment: flow quality and quantity assessment
IS 1-SP 4	Wetfall and dryfall input directly into the coastal zone
Ecological processes	
EP 1	Assessment of the effects of inputs to the Adelaide coastal waters on seagrass ecosystems and key biota
Environmental information systems	
RS 1	Remote sensing study of marine and coastal features and interpretation of changes in relation to natural and anthropogenic processes
Physical processes and modelling	
PPM 1	Coastal sediment budget
PPM 2	Physical oceanographic studies in the Adelaide coastal waters, using high resolution modelling, field observations, and satellite techniques.
Environmental monitoring program	
EMP 1	
	Spatial/temporal design; statistical analysis; quality assurance and control
Stage 3 Synthesis and reporting tasks	
DST MM 1	Development of a coarse-resolution management model of the Adelaide coastal waters

3 RESEARCH OUTCOMES – KEY UNDERSTANDINGS

The study has adopted three levels of reporting: 1) a high-level overview and summary of main results (this document, Final Study report Volume 1); 2) a detailed findings (Final Study report Volume 2); and 3) highly specific task results (Task reports 1-20 listed on page vivii). All reports are available for download from www.clw.csiro.au/acws.

A summary of the main study findings is given in Table 3 and these are expanded upon in the following subsections.

Table 3. Summary of main findings

Environmental asset or process	Stressor or threat	Management issues / knowledge gaps	Finding(s)
Water quality			
	Pollutants from stormwater (rivers, creeks, drains)	▪ Nutrient and sediment loads – quantify and develop meaningful targets	▪ Historically, very small contribution; now contributes about 30% of total volume. ▪ Engineering works (diversion of Torrens River; proliferation of drains; dune modification) and urban development responsible for dramatic increase in loads. ▪ Significant quantities of 'freshwater' being exported to coastal marine environment each year (approx. 115 GL from stormwater). ▪ Seasonal patterns in flow mean that summer–winter discharge is in ratio 7:93. ▪ The Torrens River typically contributes about 20 GL/y; approx. 15 GL/y for each of the Onkaparinga, Patawalonga, and Gawler rivers. Barker Inlet delivers about 30 GL/y. ▪ Stormwater now carries high annual loads of suspended sediments, dissolved organic material, and nutrients: approx. 153 tonnes nitrogen; 20 t phosphorus; 1.3 t copper; 1.5 t lead; 7000 t sediment. ▪ Stormwater-derived sediments largely responsible for turbidity in coastal zone (peaking between August to November).
		▪ Other chemicals of concern – identify, quantify, and assess risk	▪ Concentrations of copper, lead, and zinc exceed national 'trigger' values (typical values in creeks: copper 0.016 mg/L; lead 0.07 mg/L; zinc 0.09 mg/L. ▪ Highest lead loads May through September. ▪ Pesticides have been detected in stormwaters (most notably the Torrens River). ▪ Water quality severely compromised during storm events (turbid plumes). *NB: human health impacts were not investigated by this study*. ▪ Nutrient concentrations tend to be higher in summer than winter. ▪ Nutrient concentrations higher near shore (<5 m depth).

Environmental asset or process	Stressor or threat	Management issues / knowledge gaps	Finding(s)
Water quality			
	Pollutants from wastewater treatment plants (including sludge outfalls)	▪ Nutrient and sediment loads – quantify and develop meaningful targets;	▪ Approx. 43% (approx. 75 GL/y) of water discharged to marine environment is from WWTPs. ▪ Distribution of inputs: 47% Bolivar; 23% Glenelg; 18% Port Adelaide[#]; 12% Christies Beach. ▪ Seasonal patterns in flow mean that summer-winter discharge is in ratio 35:65. ▪ Typical analysis:1000 tonnes nitrogen/y; 2000 t particulates/y; 340 t phosphorus/y; 3 t copper/y; <0.5 t lead/y. ▪ Nitrogen sources: 38% Bolivar; 38% Christies Beach; 24% Glenelg. ▪ Phosphorus sources: 38% Bolivar; 43% Glenelg; 19% Christies Beach. ▪ Phosphorus concentrations are not predicted to change between 2004 and 2020 except north of Port River where an increase is predicted.
		▪ Other chemicals of concern – identify, quantify, and assess risk	▪ Particulate sources: 85% Bolivar; 11% Glenelg; 4% Christies Beach. ▪ Copper: 2 tonne/y (Bolivar), 0.8 t/y (Glenelg), 0.25 t/y (Christies Beach). ▪ Lead: 0.15 tonne/y (Bolivar), 0.05 t/y (Glenelg), 0.01 t/y (Christies Beach). ▪ Zinc: 1.8 tonne/y (Bolivar), 1.5 t/y (Glenelg), 0.5 t/y (Christies Beach).
	Pollutants from Industry	▪ Other chemicals of concern – identify, quantify, and assess risk	▪ A range of organic contaminants has been detected in treated wastewater including phenols, phthalate esters, chlorinated hydrocarbons, organochlorine pesticides, and phenoxy acid herbicides. ▪ These are detected only sporadically and generally at low concentrations. ▪ These organics not thought to be implicated in any seagrass loss.

Environmental asset or process	Stressor or threat	Management issues / knowledge gaps	Finding(s)
Water quality			
			▪ Penrice Soda responsible nearly 1/2 of total nitrogen entering coastal zone (approx. 1000 tonne/y at time of study, most recent estimate is 850 t/y). ▪ Overall, nitrogen concentrations decreased between 1965 and 2004 (most notable in the north from more recent decreases in Penrice Soda nitrogen load). ▪ Nitrogen concentrations not expected to change between 2004 and 2020 except in north of Port River where an increase is predicted.
	Non-land based pollutants (atmosphere, rain, groundwater)	▪ Relative contribution from these sources	▪ More than 1/2 (213 GL/y) of the freshwater delivered to the coastal zone is as rainfall; groundwater contributes only 1% to the total input. ▪ Nearly 20% of the particulate matter delivered to the coastal waters is from the atmosphere. ▪ Rainfall to the coastal waters contributes approx. 33 tonne/y nitrogen and 5 t/y phosphorus. ▪ Approx. 45% (1.3 tonne/y) of lead is delivered to the coastal waters comes from the atmosphere as well as about 1/4 t/y of copper. ▪ The only nutrient in appreciable quantities delivered by groundwater is nitrogen (50 tonne/y).
	Toxicants (all sources)	▪ Identify, quantify, and assess risk	▪ Very little concentration data available with toxicants being detected sporadically (some exceptions are high nickel concentrations at Glenelg, Brighton, Port Noarlunga) and high zinc along metro coastline. ▪ Previous reports suggest high metal concentrations may be harmful to ecosystem health (although not considered a threat to seagrasses). ▪ Glyphosphate was detected after significant rainfall events.

Environmental asset or process	Stressor or threat	Management issues / knowledge gaps	Finding(s)
Water quality			
	Biological activity	▪ Identify, quantify, and assess risks	▪ Increased nutrient loads increase risk of algal blooms in near-shore waters (<5 m) - particularly in and around the Torrens River and Barker Inlet. ▪ This risk is increased under conditions of: high nutrient loads, 'dodge' tide, calm winds, and high solar radiation. ▪ Ambient nutrient levels off-shore are generally low (waters are classified as oligotrophic). Stable nitrogen isotope work undertaken as part of this study has confirmed that WWTP-derived nitrogen is being transported well off shore causing exceedence of ANZECC/ARMCANZ trigger values on occasions. ▪ Nitrogen from WWTPs and Penrice is being taken up in significant quantities by seagrasses close to, and distant from, these sources. ▪ Maximum levels of chlorophyll-a, faecal coliforms, and dissolved organic carbon detected in vicinity of Barker Inlet. ▪ Summer inflows from Barker Inlet/Port River system can become trapped in this region, increasing the risk of algal blooms and contamination.
	Reduced salinity	▪ Determine volume of freshwater discharged to marine environment	▪ Freshwater volumes noted above. ▪ For Gulf St Vincent, evaporation exceeds rainfall, so waters tend to be hyper-saline. ▪ Metro waters have salinity of 37 psu which increases slightly (+1 psu) over summer.
		▪ Dispersion characteristics	▪ Waters are warmest in late summer (> 25°C) and coldest in late winter (~12°C). This temperature difference controls overall density of Gulf waters.
		▪ Assess ecosystem impacts	▪ Metropolitan coastal salinity and temperature strongly influenced by Gulf-wide circulation patterns.

Environmental asset or process	Stressor or threat	Management issues / knowledge gaps	Finding(s)
Water quality			
		▪ Reduce discharge to sea	▪ Average salinity decreased along entire coast between 1965 and 2004 except Barker Inlet/ Port River system which increased. ▪ Average salinity between 2004 and 2020 is predicted to remain unchanged, except Barker Inlet/Port River system whic h is predicted to decrease.
	Suspended sediments/particulates	▪ Suspended sediment loads - quantify and develop meaningful targets ▪ Evaluate and assess environmental risk	▪ Sediment/particulate loads noted above. ▪ Near-shore waters (<5 m) typically well mixed but can be highly turbid after significant rainfall events and this can persist for extended periods (> 10 days). ▪ Within the study region, suspended material is mainly phytoplankton to the west and a mixture of CDOM, tripton, and phytoplankton near the coast. ▪ Concentrations of suspended matter are about three times higher in the northern regions (particularly near Barker Inlet) than southern regions. ▪ Suspended sediment concentrations generally decreased between 1965 and 2004 although increases around Bolivar were evident. ▪ Suspended sediment concentrations not predicted to change between 2004 and 2020 except in Port River system and Bolivar region which is expected to reduce.
	Dissolved organic matter	▪ Identify sources, spatial and temporal distribution ▪ Assess risk and identify actions to mitigate	▪ Major constituents in the water column are phytoplankton, tripton, and CDOM (by-products from decomposition of seaweed and other plant material). ▪ Light absorption in water column mostly due to CDOM component. ▪ CDOM levels in near-shore zone thought to be influenced by seasonal variation in freshwater inputs.

Environmental asset or process	Stressor or threat	Management issues / knowledge gaps	Finding(s)
Sediments			
	Transport	▪ Develop understanding of physical processes and how these affect and are influenced by other processes ▪ Develop sediment budget - source, sinks, and fate	▪ Sediments come from both marine and terrestrial sources. ▪ Transport rates out of equilibrium; net drift and accumulation to north. ▪ approx. additional 100,000 m^3/y of sediment* being delivered to coastal zone.
	Remobilisation of pollutants	▪ Assess potential for nutrients and other contaminants to be released from sediments ▪ Assess risk and identify actions to mitigate	▪ Very little data on sediment contaminants although: - Previous work has revealed high concentrations of some metals in Port River estuary but low elsewhere. - Chromium and zinc were detected over broad area of the coast. - Copper detected only around Bolivar. - Relatively high concentrations of chromium and zinc in deeper waters of southern portion of study region. - Limited sampling suggests: below detection levels for organochlorine/organophoshate pesticides; triazine herbicides; glyphosphate; polycyclicaromatic hydrocarbons; petroleum hydrocarbons. - Within seagrass meadows of Holdfast bay, sediment nutrient levels (particularly ammonia) were higher than water column concentrations.

Environmental asset or process	Stressor or threat	Management issues / knowledge gaps	Finding(s)
Sediments			
	Stability	▪ Interaction between seagrass loss and sediment stability	▪ Seagrass loss exposes underlying sediments which subjects them to greater erosive forces and hence increased mobilisation. ▪ Actual rates of movement/loss dependent on a number of factors including depth and particle size. ▪ Currents near sea-floor range from 0.2 to 0.8 m/s. ▪ Results suggest that wave-induced currents in the near shore region are capable of mobilising fine to medium sized sands almost continuously.
Seagrasses			
	Initial loss	▪ Identify probable causes for historical loss of seagrass ▪ Reconstruct initial species composition and distributions	▪ Approx. 4000 ha loss between 1949 and 1995; most recent estimate is 5200 ha[+]. ▪ Much of this loss occurred in the mid 1970s – about 8 years after the peak in Adelaide's rate of population increase although loss has been continuous and episodic. ▪ Pattern of loss is unusual in that it commenced close to shore and progressed off-shore. The 'blue line' is now about 1 km off-shore. ▪ Seagrasses mostly comprised of *Amphibolis* and *Posidonia*; *Amphibolis* appears to be particularly susceptible to land-based discharges. ▪ Significant early losses around Port Adelaide sludge outfall with minimal re-establishment. ▪ Spatial patterns: significant losses in northern regions (vicinity of Bolivar WWTP and Barker Inlet); losses in central region (Holdfast Bay) commenced in 1940s; little documented evidence of declines of seagrass in southern regions although this cannot be ruled out. ▪ Initial losses have been linked to stormwater drains, sludge outfalls, wastewater discharges, coastal development, diversion of Torrens River. ▪ Primary causative agent of seagrass loss is most likely high nutrients (nitrogen); more complex and subtle interactions between nutrients, light, turbidity, and colour also thought to be involved.

Environmental asset or process	Stressor or threat	Management issues / knowledge gaps	Finding(s)
Seagrass			
	Continuing loss	▪ Identify probable causes for continuing loss of seagrass	▪ Continuing loss (and/or lack of re-establishment) is thought to be a nutrient-related issue although other factors may come into play once seagrasses have been lost e.g. greater shear stresses on seafloor, lack of suitable substrate for seed propagation, increased frequency and severity of 'blowouts'.
		▪ Identify possible causal mechanisms for lack of recruitment and on-going decline	▪ Preliminary benthic chamber experiments suggest that about 31% of the total ammonium and <1% of the total nitrate that is discharged into the coastal system is used by seagrass complexes (seagrass and epiphytes). However, these estimates may not be indicative of long-term uptake and further work is required to more accurately describe nitrogen cycling within sediments - including rates of remineralisation, nitrification, and denitrification.
		▪ Predict future losses under variety of scenarios	▪ Degraded light climate (see below) in near shore zone compromises photosynthesis and may offer a partial explanation for lack of re-colonisation in this region.
	Epiphytes	▪ Develop understanding of interaction between nutrient loads, epiphyte growth, and seagrass vitality	▪ nitrogen uptake by epiphytes on *Amphibolis* is higher than uptake rates for epiphytes on *Posidonia*.
			▪ There is strong evidence to suggest an epiphyte-mediated seagrass decline.
	Light climate	▪ Develop understanding of spatial-temporal relationships between water quality and light climate	▪ Seagrasses have a high light requirement: typically between 5% to 30% of surface irradiance although *Posidonia* was observed at 18 m depth where the annual average was 4% of surface irradiance.
			▪ Light climate in near-shore zone critically dependent on prevailing conditions in terms of: quality/quantity of discharges; weather conditions; physical transport; re-suspension.
			▪ Optical properties of the metropolitan waters can be severely degraded during storm events. Outflows from the Torrens River and Barcoo Outlet play a significant role during these periods.

Environmental asset or process	Stressor or threat	Management issues / knowledge gaps	Finding(s)
Seagrass			
	Light climate		▪ Restoration of 'normal' light conditions after a significant storm event can take up to two weeks. ▪ Light availability at 3 m depth during storm events can be much less than at deeper sites (> 10 m).
	Water quality	▪ Develop understanding of interaction between water quality and seagrass vitality	▪ Major constituents in the water column are phytoplankton, tripton, and CDOM (see under Dissolved Organic Matter above). ▪ Seagrass vitality is compromised by high nutrient levels (nitrogen). ▪ Reduced salinity unlikely to be cause of seagrass loss. ▪ High turbidity levels reduce the light reaching the seabed. Light reductions below the minimum required (see 'light climate' above) compromise seagrass vitality. This study has not been able to quantify the impact on seagrasses due to the *combined* effects of high nutrient and turbidity levels. ▪ Direct toxicant effects unlikely to be responsible for seagrass loss. ▪ A detailed model that links these factors and allows 'what if' scenarios to be explored is being developed as part of Stage 3 of the study.

* As of January 2005, Port Adelaide discharge diverted to Bolivar high salinity treatment plant

DEH, Coastal Protection Branch

+ The two estimates are not directly comparable since they have different geographical extents



3.1 Physical Processes

Within the study region, tidal currents dominate the circulation pattern, with wind having a secondary effect through its influence on the mean circulation pattern, particularly at the surface. Current patterns align parallel to the coastline. The seasonally varying wind climate produces a reversal in the mean circulation pattern: in summer, the net movement of water is northwards, whereas during winter the direction is reversed towards the south; however, as the southerly and southwesterly winds are stronger and more prevalent, the annual movement of water is northward. In the near-shore zone, because of the dominance of wave-induced currents, the net flow is towards the north.

3.1.1 Nutrient transport

Because of the predominantly along-shore movement of water, land-based discharges are mainly transported in a north-south direction, parallel to the coastline, with minimal offshore dispersion. The near-shore waters, inshore of the 5-m depth contour, had higher residence times than those further offshore and varied between 1 and 10 days depending on weather conditions. During the summer, the mean residence times were lower (1-1.5 days), whereas during winter the mean residence times were slightly higher (up to 2.5 days).

The Port River/Barker Inlet system has a major influence on nutrient and suspended sediment concentrations within the study region. This is through a combination of industrial (Penrice), wastewater, and stormwater discharges. In summer, the discharges were transported northwards from the Port River entrance, whereas during winter there was southerly transport with discernable impact along the Adelaide coastal strip. Discharges from the Bolivar outfall did not appear to have a direct influence on the Adelaide coastal strip. The relative importance of stormwater and wastewater discharges (industrial and municipal) depended on the particular nutrient (nitrogen or phosphorus) and also on season. During summer, discharges from wastewater outfalls (which included Penrice) had greater influence on the magnitude and extent of the suspended sediment concentrations, whereas in winter the stormwater discharges had a larger influence. For nitrogen concentrations, stormwater discharges resulted in higher concentrations during the summer, whereas wastewater discharges were dominant in winter. With respect to phosphorus concentrations, stormwater discharges were dominant along the metropolitan coastal strip during both summer and winter, whereas the wastewater discharge from Bolivar was dominant along the northern section.

3.1.2 Sediment transport

Sediment transport occurs along the Adelaide coastline due to the combined action of waves and tidal currents. Close to shore, it is the wave action that is important whereas outside the surf zone, as the depth increases, the influence of waves is generally diminished. The net northerly drift of sediments along Adelaide's coast is a consequence of wave- and current-induced shear stresses being exerted on the seabed. The rate at which sediment is transported is a function of the magnitude of this bottom shear stress, sediment grain size, and sediment density. Adelaide's coastal sediments are predominantly quartz and

carbonate species, with only a small fraction of clay minerals. The quartz fraction of sediments is higher in the inshore regions and the carbonate fraction is more prevalent in the offshore regions. It is these smaller, non-cohesive inorganic sediments that are readily mobilised along the metropolitan coastline.

The transport of sediments has important implications for seagrass recovery. In Adelaide, the most likely scenario is that once seagrass becomes lost from further offshore, the seabed becomes scoured, water depth increases, and higher energy wave action occurs closer to shore. *Amphibolis* is expected to recover first as it has been observed to grow in shallower sediments overlying a calcrete base. The recovery of *Amphibolis* would lead to the trapping of sediments, and this would facilitate the recovery of *Posidonia*. That this mechanism appears not to have occurred to any appreciable extent is most likely due to the fact that *Amphibolis* is more susceptible to eutrophication. Any long-term strategies for seagrass recovery will need to break this loop.

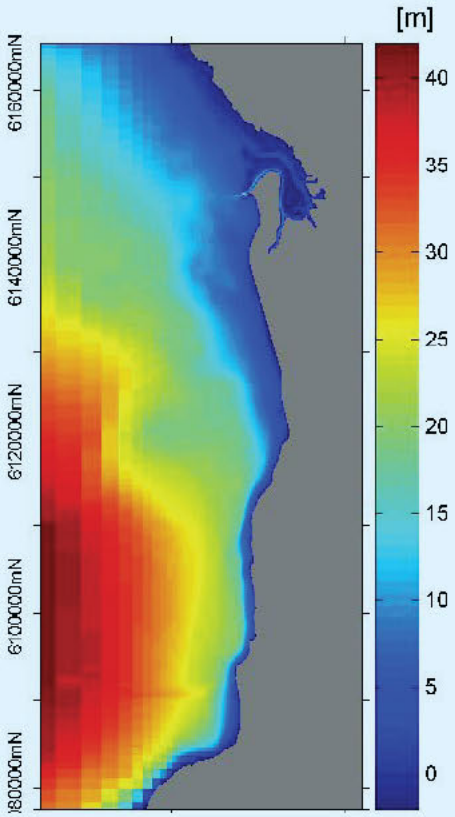


Figure 6. Bathymetry (depth soundings) for the study region.



3.2 Inputs – Water Quality

Adelaide's coastal zone receives inputs from a variety of 'point' and 'diffuse' sources. Point sources include wastewater treatment plants (WWTPs), rivers, streams, creeks, and drains, while diffuse sources are groundwater and atmospheric deposition. The major inputs and chemical constituents within a 10-km-wide strip along the coast from the Gawler River to Sellicks Beach are summarised in Figure 7. About 391 GL of water enters this strip annually - approximately half as rainfall and half from WWTPs and stormwater. During the period April 2001 to April 2003, about 43% of the water discharged from land-based sources came from WWTPs. Since 1945, a total of approximately 2000 GL of wastewater has been discharged directly into the Adelaide coastal zone, with about a quarter of this coming from Bolivar in the last 20 years. Although significant in volume, the very low concentrations of nitrogen and other trace constituents in rainwater means this is an insignificant source when compared to land-based inputs. Of the estimated 2453 tonnes of nitrogen entering this zone annually, 90% is derived from WWTPs and Penrice Soda (49% and 41% respectively). The wetfall (or rain) input accounts for around 30 tonnes of nitrogen annually while dryfall (or dust) contributes less than 1% of total nitrogen. It is possible that further Environment Improvement Programs (EIPs), such as the one implemented by the SA EPA during the 1990s, may reduce the total nitrogen load to around 700 tonnes/y (see Recommendation #2).

Dryfall deposition contributes a significant component (18%) of the solids input to the coastal strip with an annual load of nearly 2000 tonnes from this source. Since particulates have higher levels of lead and copper, they have also contributed significantly to the total copper (5%) and total lead (44%). With the gradual phasing out of leaded petrol since the late 1980s, the concentration of lead in the air has declined dramatically. This has also reduced the indirect inputs of lead to the near-shore zone because stormwater now carries significantly less of this element. In the early 1990s the lead load to the immediate coastal zone was around 2 tonnes/y, whereas now it is near 0.4 tonnes/y (an 80% reduction).

Heavy metal concentrations are appreciably lower now than in the 1970s, and loads have been reduced dramatically since the early 1990s. Copper, lead, and zinc are the most prevalent metals found in metropolitan waters. Figure 8 shows the loads (kg) of copper, lead, and zinc from a number of creeks and rivers along the metropolitan coast between 1996 and 2004. In the case of copper and zinc, these are almost entirely from land-based discharges, while over 90% of lead comes in almost equal proportions from dust and stormwater.

Since load is the product of flow and concentration, part of the observed reduction is attributable to reduced flows due to drought. To reduce the effects of varying flow, the data have been re-expressed as mean annual concentrations (Figure 9). The most pronounced reductions occurred between 1996 and 1997 - particularly in the Sturt and Torrens Rivers where copper and zinc concentrations fell by about 50% and the lead concentration dropped by about 75%. This equates to load reductions of 4.2 tonnes for copper, 25.8 t for lead, and 35 t for zinc from these two sources between 1997 and 2004.

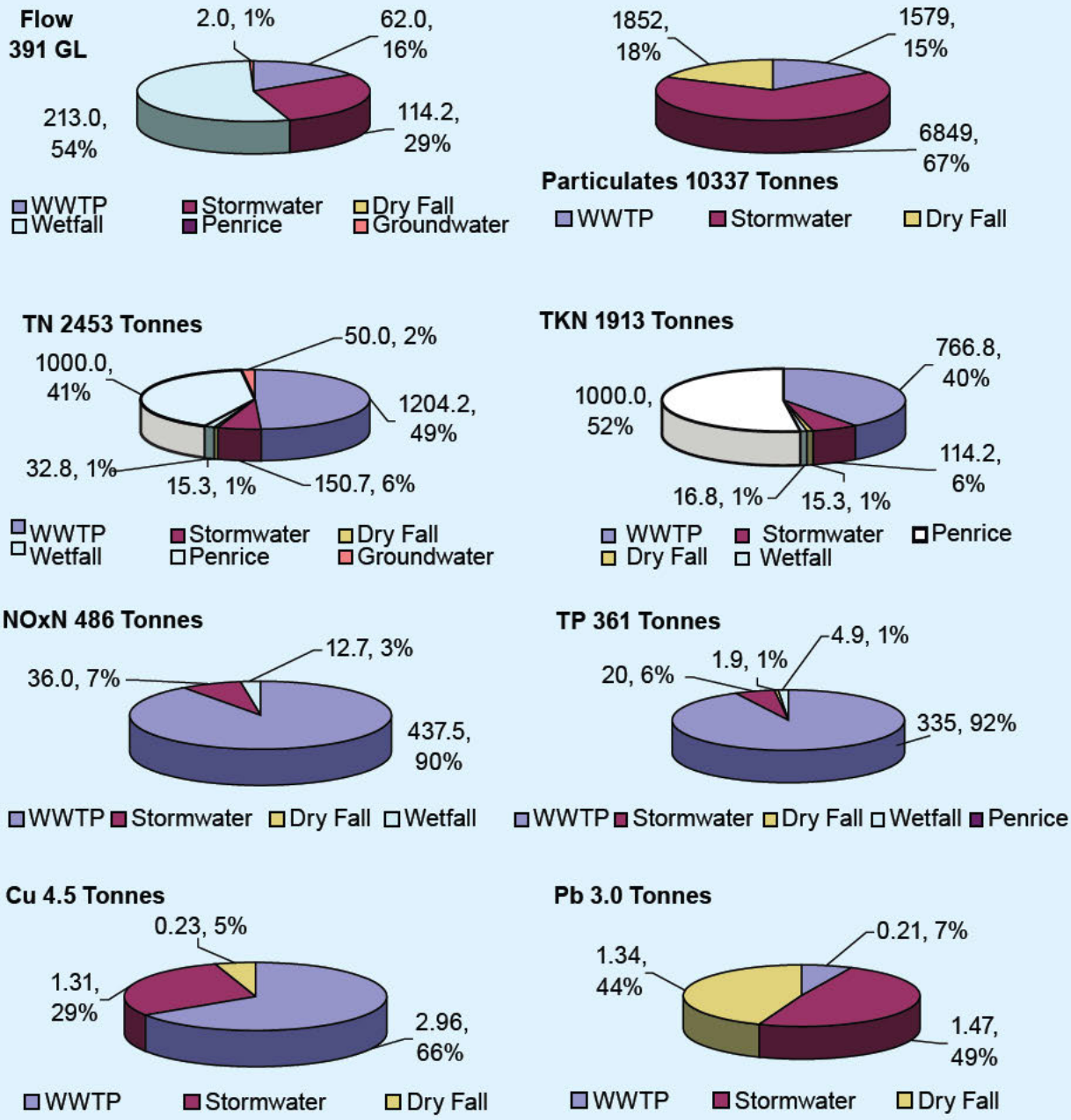


Figure 7. Summary diagram showing the annual contribution of wetfall and dryfall loads to the ACWS area (based on data collected between 2001 and 2003).

The average concentrations of copper, cobalt, zinc, and chromium from Bolivar, Glenelg, and Christies Beach WWTPs were all in excess of the ANZECC/ARMCANZ (2000) trigger levels for the protection of 95% of marine life. Of these metals, copper is between 20 and 43 times the trigger value and cobalt, zinc, and chromium are between two and four times the trigger value.

Organic contaminants such as pesticides, PCBs, PAHs, POPs, etc. have only been detected sporadically. This lack of detection suggests that these substances, if present at all, are present

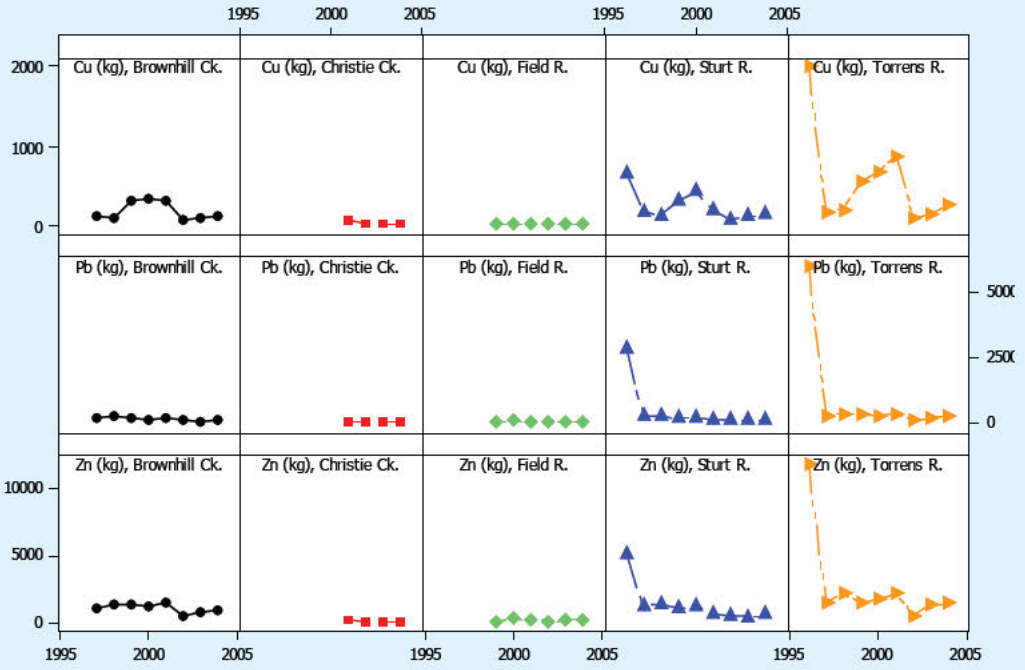


Figure 8. Loads (kg) of selected heavy metals from metropolitan creeks and rivers between 1996 and 2004.

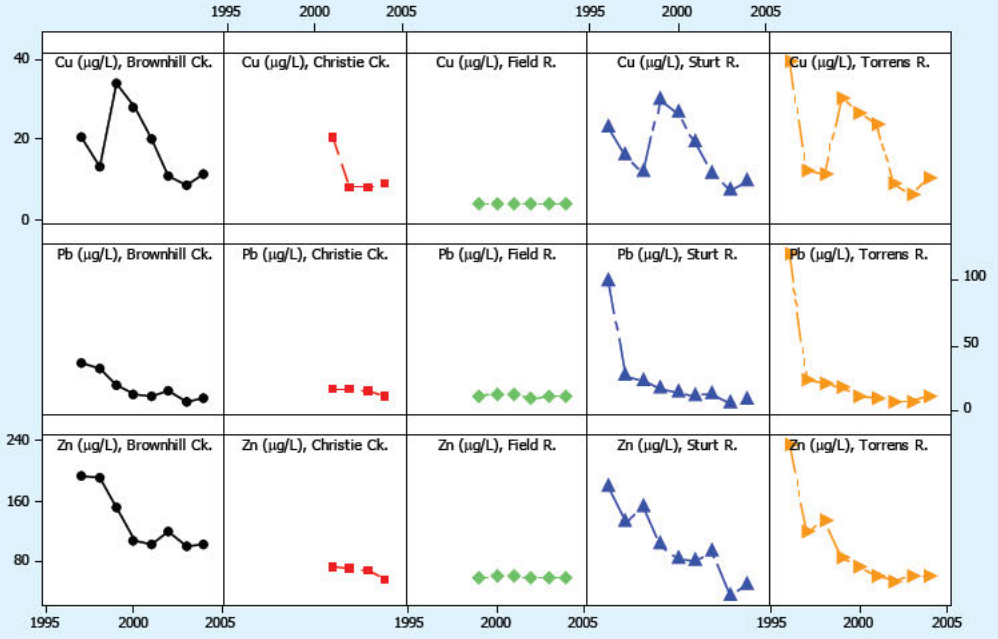
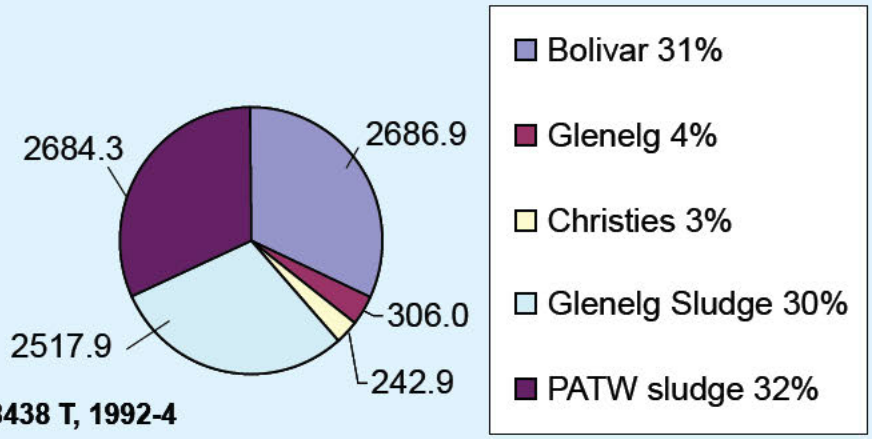
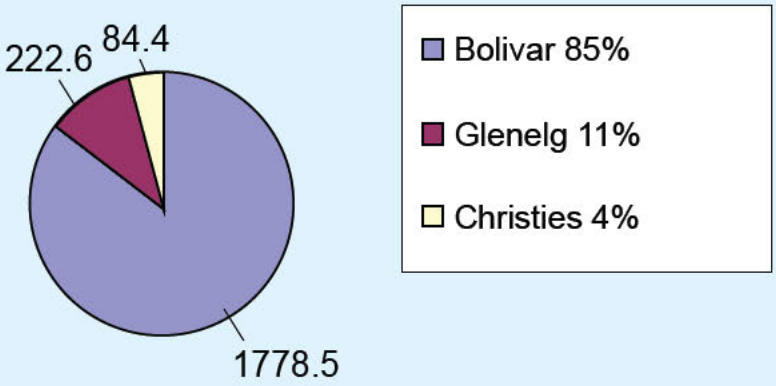


Figure 9. Mean annual concentrations (µg/L) of selected heavy metals for metropolitan creeks and rivers between 1996 and 2004.



(a) 8438 T, 1992-4



(b) 2085 T, 2001-3

Figure 10. Suspended solids loads from the WWTPs in (a) the early 1990s and (b) after the cessation of digested sludge discharges and upgrading of Bolivar WWTP (2001/03).

at very low concentrations and are of low significance when set against the other bulk inputs of substances known to have a major impact on the system. Figure 10a illustrates the typical annual loadings of suspended solids from the WWTP effluents and sludge outfalls at the end of the period during which the sludge outfalls were still in operation. During the early 1990s the sludge outfalls accounted for around 62% of the annual solids load from WWTP sources, and Bolivar WWTP accounted for 31%. Glenelg and Christies Beach only contributed only 7% of the load. The cessation of sludge dumping in 1993 eliminated a major source of particulate matter to the Adelaide coastline. The WWTPs currently discharge around 2000 tonnes/y (Figure 10b) compared to 8400 tonnes in the early 1990s (the latter figure includes sludge discharges). This is a four-fold reduction in the overall WWTP derived load, with the treated wastewater (i.e. non-sludge) load falling to 64% of the load in the early 1990s.

A more detailed breakdown of flows and suspended sediment loads from land-based sources is shown in Figure 11, while Figure 12 shows the breakdown for nitrogen and phosphorus loads.

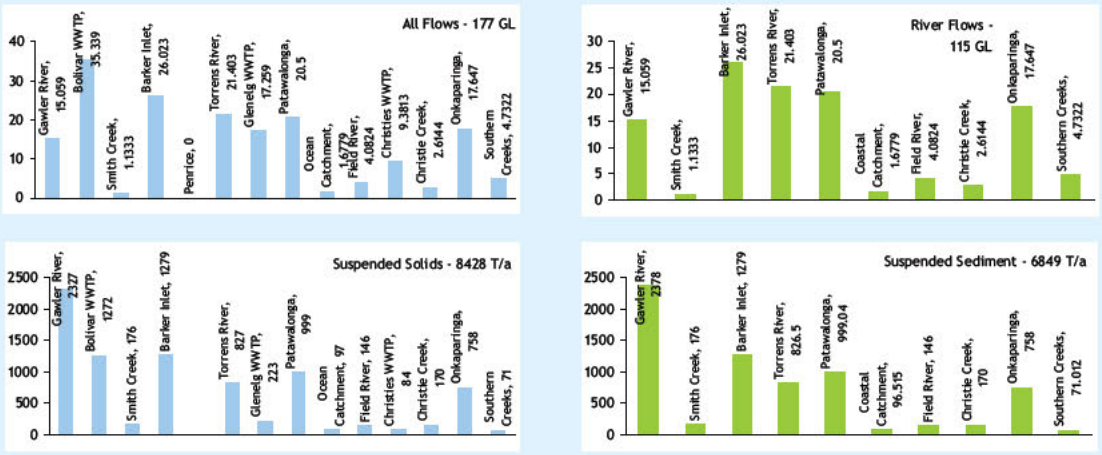


Figure 11. Breakdown of flow and solids for combined WWTP and stormwater (left panels), and stormwater only (right panels) based on data collected during 2001/03. Note: Gawler River load is an estimate only.

At Christies Beach the annual nitrogen load peaked at approximately 370 tonnes/y in 1996/97, a period when total nitrogen concentrations exceeded 35 mg/L. Ten years after the cessation of sludge disposal to sea, and following the upgrade of Bolivar to activated sludge, the nitrogen load dropped to 1000 tonnes/y. Treatment upgrades at Glenelg reduced the mean nitrogen concentration from around 30 mg/L to 20 mg/L, resulting in reduced nitrogen loads from this source. The nitrogen load from Christies Beach in 2002/03 was greater than in the 1986 to 1992 period (236.4 t/y of 213.4 t/y), partly as a consequence of the growth in connections and load into the plant. This load is net of the Willunga Basin Transfer which has reduced the annual discharge volume since 1999.

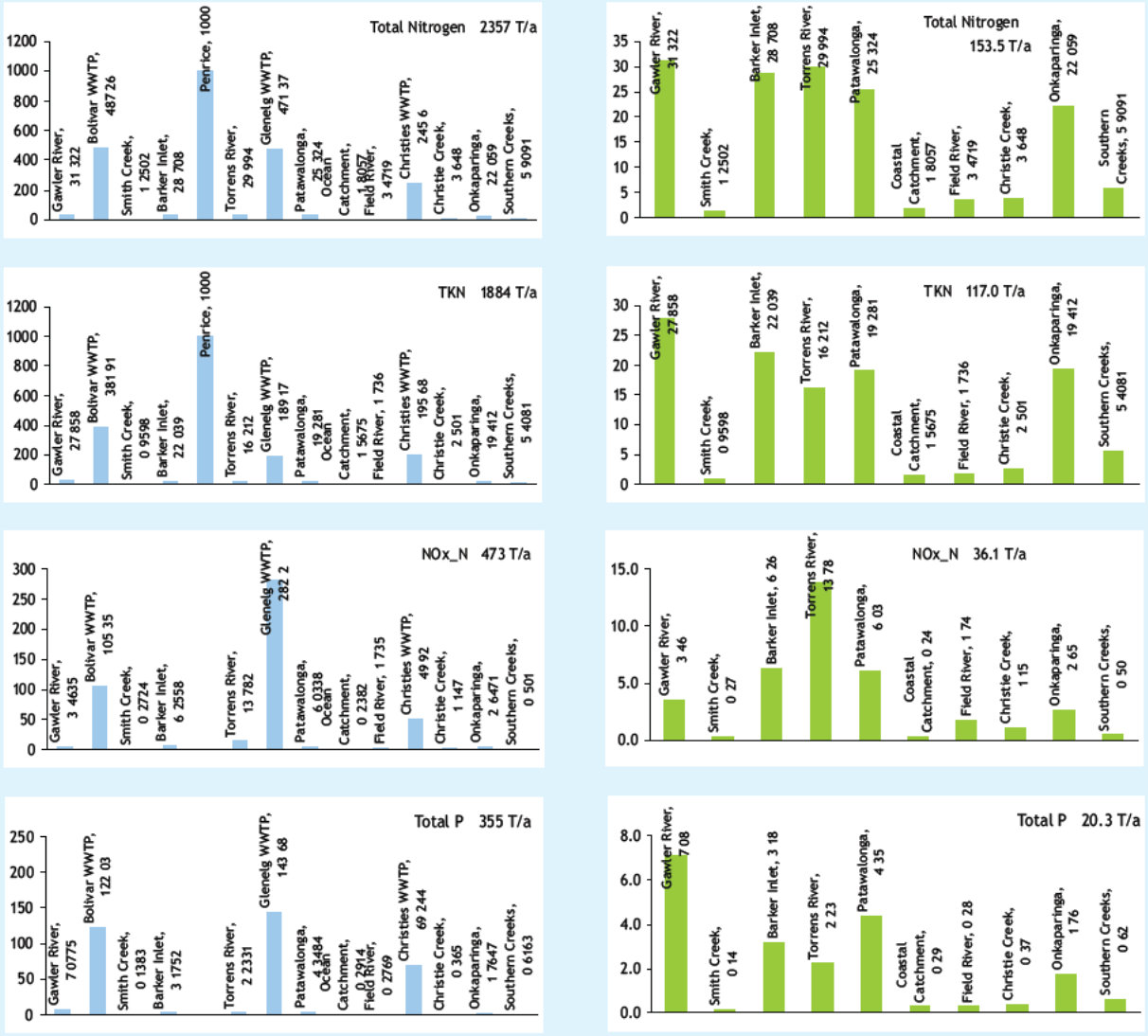


Figure 12. Breakdown of annual nitrogen and phosphorus loads for combined WWTP and stormwater (left panels), and stormwater only (right panels) based on data collected during 2001/03.

A detailed breakdown of selected heavy metal loads from the three main WWTPs and the old sludge outfalls is shown in Figure 13. The dramatic reduction in these loads since the early 1990s is clearly evident. The decommissioning of the sludge outfalls significantly reduced the loads of silver, copper, chromium, and zinc while treatment improvement processes at Bolivar and Glenelg resulted in substantial reductions of cadmium, nickel, and lead.

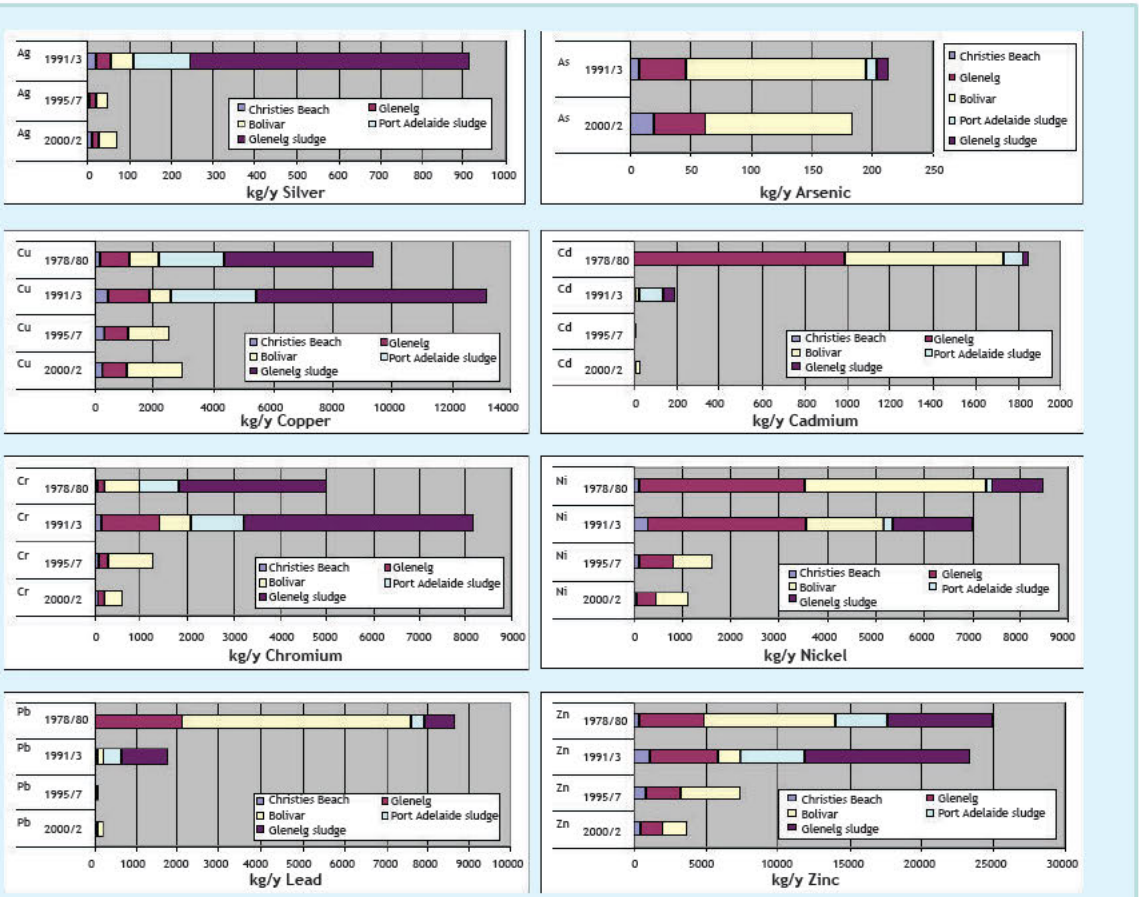


Figure 12. Loads for selected metals from Christies Beach, Glenelg, and Bolivar WWTPs as well as loads from decommissioned sludge outfalls at Port Adelaide and Glenelg.



3.3 Sediments

The renewable sediments in the study region are predominantly carbonate and quartz grains of varying size. The carbonate grains are produced by metabolic processes of marine flora and fauna within the region, while the quartz grains are generated by cliff erosion and scouring of catchments generally outside the region and transported by Gulf circulation processes. Relict grains represent a significant fraction of the sediment components, although this is not a renewable fraction. The numerous rivers, creeks, and drains along the study coastline periodically deposit large quantities of fine sediment to the inter-tidal area, resulting in highly turbid near-shore waters. Suspended sediments are also introduced to the coastal strip from waste-water treatment plants and industry (e.g. Penrice Soda). There is a marked decrease in the carbonate fraction in the sediment in the inter-tidal and beach zones in the study area, except in the northern region. This contrasts with other South Australian coastal areas that have extensive seagrass beds closer to shore. There is a correlation between mineralogical composition of the sediment grains and distance of the seagrass line from the shore.

Seagrass beds provide a favourable environment for biogenic carbonate production, and also supply an ideal substrate for calcareous epiphytes. Many of these are transported to the beach with the shedding of seagrass leaves, where they remain

as carbonate sand grains once the seagrass decays. This process represents a significant source of sediment grains. For example, each year a kilogram of seagrass produces about 1 kg of carbonate sediment at Semaphore and about 0.3 kg at Marino.

3.3.1 Coastal sediment quality

Relative to water quality, few data are available on coastal sediment quality for Adelaide's coastal waters. No data exist on nutrient levels in Adelaide's coastal sediments. The waters immediately off Holdfast Bay have been eutrophic for some decades now. It is possible that under conditions of high nutrient loads, nutrient-laden sediments and organic material accumulating on the substrate could result in increased levels of porewater nutrients. While sediment nutrient levels were not measured as part of the current study, results of benthic chamber work as part of Task EP 1 (Nayar et al. 2006) indicate that for seagrass environments in Holdfast Bay, sediment nutrient levels (particularly ammonia) are much higher than in the overlying water column. However, this is probably due to the naturally high organic content of sediments in seagrass meadows (Romero et al. 2006), and seagrasses seem to be more tolerant of higher levels of nutrients in sediments than in water (Ralph et al. 2006).

Based on a limited sampling of sediments, ACWS Task EP1 made the following observations:

- Concentrations of organochlorine and organophosphate pesticides, triazine herbicides, glyphosate, polycyclic aromatic hydrocarbons, and total petroleum hydrocarbons were all below detectable limits in the 12 sediment samples that were laboratory tested.
- The heavy metals chromium and zinc were detected at all 10 sites examined, while lead was detected at eight of the 10 sites.
- Copper was detected at only two sites.
- Concentrations of four heavy metals were low, with ranges of 0.6-11, 0.5-23, 0.96-4.3, and 0.73-0.85 mg/kg dry wt for chromium, zinc, lead, and copper, respectively. These levels are all well below the ANZECC/ARMCANZ (2000) recommended sediment quality guideline trigger values of 80, 200, 50, and 65 mg/kg dry wt, for chromium, zinc, lead, and copper, respectively.
- There were no clear spatial patterns related to depth, except in the southern part of the study region where levels of chromium, lead, and zinc were all markedly higher at depth.
- Sites in the vicinity of the Torrens River and Barcoo outlet had low levels of chromium, lead, and zinc compared to sites further offshore where those compounds were also detected.



3.4 Seagrasses

The ACWS has contributed fundamental insights into the mechanisms and factors controlling the loss, recruitment, and vitality of Adelaide's seagrasses. An innovative research program that coupled laboratory-based results with *in situ* observational and manipulative experiments has for the first time provided compelling evidence to support hypotheses of causal loss mechanisms. The major findings are summarised below.

Reduced salinity

It is unlikely that freshwater is implicated in the initial loss of seagrass off Adelaide's coastline although it may play a role in determining the capacity for natural regeneration/recovery at sites close to land-based inputs (rivers, creeks, drains, and WWTPs). Both species (*Amphibolis*

antarctica and *Posidonia sinuosa)* are highly tolerant to short-term (72 hours) reductions in salinity, with major salinity reductions required for prolonged periods (weeks) to kill adult plants. The reductions in salinity experienced along Adelaide's coast (particularly in the near-shore region where stormwater enters Adelaide's coastal waters and at locations adjacent to wastewater outfalls) are minor. However, short-term reductions in salinity can affect *A. antarctica* seedlings and *P. sinuosa* fruits. Thus, it is possible that reductions in salinity caused by stormwater and wastewater could influence recruitment processes on a very localised scale.

Toxicants

It is unlikely that toxicants (pesticides, organochlorines, hydrocarbons, herbicides, etc.) have been responsible for broad-scale historical seagrass losses. This is supported by the fact that toxicants have only been sporadically detected in very low concentrations in freshwater entering Adelaide's coastal water (which are then rapidly diluted) and that the concentrations required to affect seagrasses are relatively high. Sampling of the coastal waters following peak stormwater flows (when detection would be most likely to be undertaken) failed to detect any toxicants. Similarly, toxicant levels in sediments adjacent to stormwater outlets, as well as sites further off shore, found very low or undetectable toxicant levels. Finally, the historical levels detected in stormwater could never have reached levels capable of having an impact.

Turbidity

It is possible that increased turbidity from stormwater contributed to the broad-scale loss of near-shore seagrass.

Modelling results indicate that coastal inputs can become 'trapped' in the near-shore zone, resulting in a greatly diminished benthic light climate and that at times, light levels at 3 m depth can be so low as to cause the death of *Amphibolis* (but not at deeper depths). It is highly likely that near-shore light conditions were worse during the 1940s to 1960s (when much of the near-shore seagrass loss occurred) because discharges from the Torrens River then were significantly greater than at present. Experimental results from the Adelaide Coastal Waters Study have not been able to conclusively establish that a compromised light climate alone could have caused the loss of seagrass, although this remains a possibility.

Nutrients

It is most likely that nutrients from stormwater and wastewater were responsible for broad-scale historical seagrass losses. We now have multiple lines of evidence in support of this hypothesis, including laboratory and field-based experimental results. Historically, we know that the coastal waters have received almost continuous inputs of stormwater and wastewater for the last 70 years as well as industrial contaminants and sewerage sludge between the early 1960s and 1993. This served to increase the levels of water-column nutrients in Holdfast Bay and in the vicinity of wastewater outfalls. Perhaps the most significant initial activities (in terms of environmental impact) included the diversion of the Torrens River, waste disposal from the Glenelg WWTP, and the commencement of Penrice Soda discharges in 1940. This study has provided clear evidence that the existing offshore seagrasses from Port Gawler to Port Noarlunga *continue* to receive nitrogen sourced from WWTP and industrial outfalls (most notably Penrice Soda). Clearly, near-shore seagrasses (prior to their loss) would also have been exposed to those same nutrient sources.



Figure 14. The SARDI Aquatic Sciences tank farm where the mesocosm experiments were performed.

Results of the Adelaide Coastal Waters Study unambiguously prove that chronic, yet minor, increases in water column nutrients (as might be associated with WWTP and industrial inputs) could have caused the slow decline of *Amphibolis* and *Posidonia* in shallow, previously nutrient-poor, coastal waters. Mesocosm experiments have demonstrated that *Amphibolis* is more susceptible to nutrient enrichment than *Posidonia* — particularly in the presence of epiphytes and irrespective of depth. The existence of this effect on *Amphibolis* in the absence of epiphytes has not been unequivocally established. The present situation with respect to nitrogen input and biotic uptake in the receiving waters is depicted in Figure 15.

The findings of this study are consistent with observations in similar, nitrogen-limited marine environments which suggest that nitrogen, rather than phosphorus, plays a key role in the degradation of marine (and seagrass) systems. Inorganic forms of nitrogen (such as ammoniacal nitrogen and oxidised nitrogen) are generally of greater concern since they are biologically available. Further work would need to be undertaken to understand the effects of reducing nitrogen in Adelaide's coastal waters while leaving phosphorus loads unchanged.

In situ experiments used bags of slow- release fertiliser to provide long-term enrichment of nitrogen around pristine seagrass beds. Ammoniacal nitrogen concentrations in the treated plots were about 0.03 mg/L - about 3 times the ambient concentrations of SA coastal waters although close to (but generally less than) those now found on the Adelaide metropolitan coast (due to enrichment from wastewater and stormwater inputs). This enrichment resulted in rapid growth of epiphytes and a reduction, over a year, of the above-ground biomass. The experiments were the first manipulative studies to demonstrate that even these modest nutrient enrichments are sufficient to destroy pristine seagrass beds in a few years. A 'nutrient-epiphyte- seagrass decline model' has been developed which summarises our understanding of how increased nutrients affect seagrass (Figure 16). This model also supports previous correlative observations of seagrass loss at the Port Adelaide WWTP sludge outfall in offshore Holdfast Bay, the Bolivar WWTP outfall north of Outer Harbour, and the Glenelg WWTP outfall in near-shore Holdfast Bay.

While this model encapsulates the most contemporary understanding of the interplay between nutrients and seagrass loss, further research and development is required to definitively establish a *causal link* rather than a *correlation*.

It is possible, but unlikely, that the direct toxic effects of increased nutrients are responsible for the loss of seagrass. Ammonia is toxic to both *Posidonia* and *Amphibolis*, but only at concentrations that would be found directly adjacent to effluent discharges. Ammonia levels drop rapidly with increasing distance from the discharge point.

Finally, the effect of multiple stressors cannot be discounted. Thus, it is possible that a combination of increased nutrients and increased turbidity from stormwater and wastewater triggered the initial seaward regression of near-shore seagrasses in Holdfast Bay. Preliminary results from mesocosm experiments suggest that multiple effects are plausible. One such experiment simultaneously examined the effects of high nutrient levels, reduced light, and increased epiphyte load on *Amphibolis antarctica* and *Posidonia sinuosa*. Although an interesting interaction between ammonium concentration and light level was observed, extrapolation of these results to the field was not possible due to the unrealistically high nutrient concentrations and the short time-frame (4 weeks) used.

4 CONCLUSIONS

As Adelaide has grown, so too have the volumes and loads of nutrients, total suspended solids (turbid water), and dissolved organic carbon (coloured water) discharged to coastal waters. Furthermore, these loads of coloured stormwater are discharged directly to the Gulf, accompanied by municipal and industrial waste discharges rich in dissolved inorganic nitrogen and phosphorus. Wastewater discharges and the release of stormwater have changed the pattern of flows and loads. Urban runoff is 'flashier' than runoff from vegetated catchments, so that rainfall in urban catchments runs off quickly carrying nutrients and suspended solids from roofs, roads, and gardens. Since the rapid growth of the city in the 1960s, there has been both

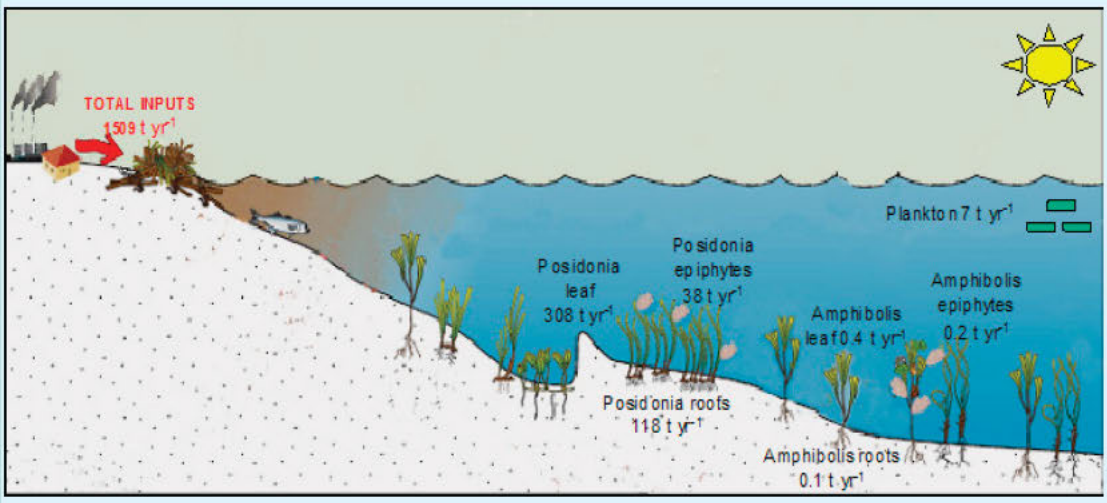


Figure 15. A simplified summary of the current annual ammonium biotic assimilation capacity in relation to the total anthropogenic inputs for the Adelaide coastal waters. Figures in tonnes of ammonium per year.

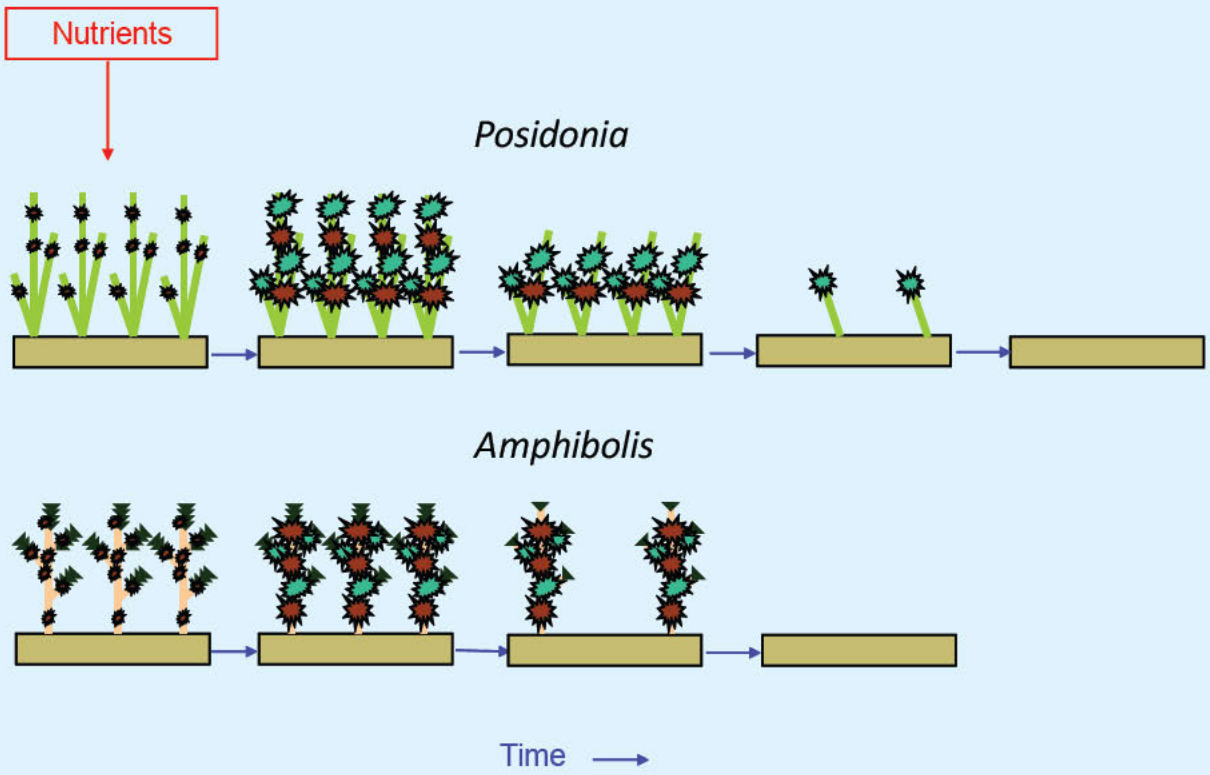


Figure 16. Schematic of the nutrient-epiphyte-seagrass decline model for *Posidonia* (above) and *Amphibolis* (below), showing how an increase in water-column nutrients can cause an increase in epiphytes and, in turn, a decline in leaf density and leaf length (for *Posidonia*) and a decline in stem density and leaf density (for *Amphibolis*), eventually ending in complete loss of both species.

a growth in the overall loads to coastal waters as well as a strong increase in summer flows. Summer flows — which would once have been practically zero — are now of the order of 5-8 GL/y. Winter catchment outflows are high in nitrate whereas summer catchment outflows are characterised by highly coloured water. So the overall load, its chemical nature, and its distribution in time have changed in the last 50 years.

All the evidence points to a key role of nitrogen loads in causing nutrient enrichment of coastal waters, growth of epiphytes, and (perhaps) direct effects on the seagrasses. There is no evidence from this study to show that toxicants or other chemical stressors play a key role in the ecosystem dynamics. This is totally consistent with the findings of other studies of coastal waters in Australia.

The major discharges of nitrogen now occur from the Bolivar WWTP, the Penrice plant, and from the Glenelg WWTP. Stormwater flows are a small fraction of the overall loads. The overall loads now amount to about 100-130 GL of water and a total nitrogen load of about 2350 tonnes per year made up by around 850 t N/y from Penrice, 1200 t N/y from municipal wastewaters, and 150 t N/y from stormwater flows. Before human impact the nitrogen loads would have been small - of the order of 50-80 t N/y — so that, overall, we have increased the nutrient loads to the Adelaide coastal waters by a factor of 30-50.

The Adelaide Coastal Waters Study has generated a unique historical record of nitrogen (and other) loads to coastal waters, coupled with a long series of observations of seagrass cover in Adelaide coastal waters. Analysis of these historical loading trends (coupled with the realisation that there are long time lags in this system between loading increases and seagrass losses) shows that seagrass losses were widespread after the loads increased to about half the present levels.

Nitrogen loads into the ACWS coastal zone (an area of about 100 km^2) are presently estimated to be 27.5 tonne N/km^2. The residence time in this region is estimated to be of the order of 5–10 days (and as much as 30 days), making the effective nitrogen load 0.3 to 2.5 tonne N/km^2/y. This brackets the known critical load for coastal ecosystems – derived from observations in many Australian coastal waters – of 1 t N/km^2/y (Webster and Harris 2004). Certainly, seagrass loss is expected at loads around 3 t N/km^2/y – as is observed here. Although seagrass loss appears to have stabilised over the last decade, our analysis suggests that an approximate 75% reduction (based on 2003 load estimates) in nitrogen load to coastal waters is required in order to encourage re-growth and re-colonisation.

It is evident that the highly turbid, nutrient-enriched, and coloured waters entering the coastal marine environment are directly associated with degraded water quality, loss of seagrasses, and (indirectly) alteration of sediment dynamics and other physical, chemical, and biological processes. While it is well known that seagrasses have a high light requirement, this study has not been able to demonstrate that turbidity alone is responsible for historical seagrass losses. Nevertheless, turbidity is a threat to seagrasses and the combined effect of high nutrient levels and increased turbidity may result in worse environmental outcomes than from either effect alone. For this reason we believe that, commensurate with efforts to reduce the nitrogen load, a targeted reduction of total suspended sediment load is required. Using a conservative target of 12% surface irradiance at 9 m depth would mean the overall sediment load (stormwater and WWTPs) discharged to the marine environment would need to be reduced by about 50% from its current value of about 8400 tonnes. Given the uncertainties about the role of sediments in seagrass loss, coupled with the fact that this calculation does not take into account the effects of re-suspension, we suggest that the numerical target be treated as ‘aspirational’ rather than a ‘compliance’ target. Further research is required to better understand the complex interactions between light availability, suspended sediment concentrations, nutrient enrichment, and seagrass/epiphyte response.

4.1 Physical Processes

The physics of the Adelaide metropolitan coastal waters have been investigated through moorings and ship-board surveys, as well as models. All the results indicate that the main features of the coastal circulation are closely tied to the impacts of the catchment and wastewater loads. Long-shore transport by wind and tide is about an order of magnitude larger than offshore transport, so the predominant fate of catchment loads is to be trapped close inshore and to be moved up and down the coast by the tide. The predominant water movement pattern – the residual flow – is northerly in summer and southerly in winter.

Because of the loss of seagrasses along the metropolitan beaches there is now more scouring and re-suspension of sediment than previously. There appears to be sufficient energy to re-suspend fine sediments throughout the near-shore zone. Analysis of sediment types along the coast has shown that, in addition to material

sourced from adjacent catchments, carbonaceous material produced biogenically within seagrass beds is an important component. The sources of 'new' sediments are controlled by the healthy state of the sea floor in the case of carbonates, particularly the important group of calcareous epiphytes on seagrasses, by reworking of coastal environments such as dunes and cliffs and the inputs from natural drainage systems.

The effects on the ecosystems in coastal waters has been investigated by a series of light meters moored in transects off Adelaide beaches. After rainfall events, the light intensity on the bottom at 3 m and 8 m depth is frequently less than that observed at 15 m because of discoloured and turbid stormwater trapped along the shore (this would be exacerbated by sediment re-suspension inside the 'blue line' after wind and rain events.) The seasonal pattern of rainfall in Adelaide (dry in the first half of the year, wetter in the second) means that there are frequent periods in the latter half of the year when is it quite dark on the sea floor close inshore.

Modelling of the coastal circulation has shown that at the same time as stormwater flows are trapped inside the 5 m contour in winter, there is also a turbid and nutrient-rich plume of water from Penrice, Bolivar, and the Port River which moves south along the 5–8 m contour. The model indicates that total nitrogen concentrations of 0.05–0.1 mg/L can be expected in coastal waters in winter – and these are confirmed by observations. Thus during winter there are frequent periods when near-shore environments are impacted by coloured, turbid, and nutrient-enriched waters. In summer, because of the predominantly northerly flow in coastal waters, inputs from Glenelg and other stormwater inputs from southern catchments similarly impact the metropolitan coastal strip. Inputs from Bolivar and the Port River are swept to the north. Thus the northern and southern inputs alternate seasonally in terms of their significance.

Water residence times along the shore are short because of tidal and wind-induced flushing. In the coastal strip 30–35 km long and about 2 km wide (inside the 'blue line') residence times are of the order of <2 days in summer and <4 days in winter. In the larger metropolitan coastal region the residence time is longer – about 10–30 days. These residence times may be much longer during periods of 'dodge tides' when water movement is slowed.

4.2 Response of the Seagrass-dominated Ecosystems in Coastal Waters

Results of the Adelaide Coastal Waters Study unambiguously prove that chronic, yet minor, increases in water-column nutrients (as might be associated with WWTP and industrial inputs) could cause the slow decline of *Amphibolis* and *Posidonia* in shallow, previously nutrient-poor coastal waters.

A combination of mesocosm experiments and *in situ* nutrient enrichment experiments demonstrated that *Amphibolis* is more susceptible to nutrient enrichment than *Posidonia* – particularly in the presence of epiphytes and irrespective of depth. The existence of this effect on *Amphibolis* in the absence of epiphytes has not been unequivocally established. The nutrient enrichment experiments at an unimpacted site on the western side of the Gulf resulted in rapid growth of epiphytes and a reduction of the above-ground biomass over a period of one year. The experiments are the first manipulative studies to demonstrate that even these modest nutrient enrichments are sufficient to destroy pristine seagrass beds in a few years.

The Adelaide Coastal Waters Study therefore shows that the seagrasses along the metropolitan coastline have been impacted substantially through nutrient enrichment and increases in turbidity and water colour. Together these serve to damage the seagrasses directly, increase epiphyte growth, and reduce light for photosynthesis. By increasing the frequency and magnitude of input events – through catchment clearing, urban development, and by-passing of

natural wetland filters (e.g. the creation of Breakout Creek) – as well as increasing the background nutrient concentrations through industrial and urban wastewater inflows, the tolerance limits of key species have been exceeded and seagrasses have been lost from city beaches.

Sediment movement inshore of the seagrass beds is presently sufficient to prevent re-growth of seagrasses. *Amphibolis* has been shown to recruit to patches of sacking and other rough materials anchored to the bottom – so a recruitment source is available to support future recovery if conditions were conducive to recruitment and subsequent growth. Even so, recovery is expected to be slow. In other parts of the world it has taken up to 20 years for seagrasses to re-grow once suitable conditions were re-established and for both *Posidonia* and *Amphibolis*-dominated systems this time-frame may exceed 100 years. Large-scale recovery of seagrass meadows should not be expected unless dramatic and lasting reductions in coastal inputs are made. Even then, sediment instability and nutrient recycling may inhibit progress towards this objective. While evidence of modest (unassisted) recovery in the vicinity of decommissioned sludge outfalls has been noted, it is more likely that large-scale recovery of seagrass meadows along Adelaide's coast will require intervention, either in the form of provision of appropriate settlement substrate for seedlings, transplanting of mature stock, or the harvesting and planting of germinated seedlings.

5 RECOMMENDATIONS

The ACWS has demonstrated that the key management actions required are those which will reduce inputs of nutrient, turbidity, and colour in stormwater and wastewater into metropolitan coastal waters. Present nutrient enrichment levels are clearly sufficient to cause seagrass loss. This is compounded by the increased inflows of turbid and coloured stormwater and catchment runoff. Calculation of nitrogen loads from the various sources, backed up by recent stable isotope studies, underscores the significant role to be played by SA Water, catchment water management boards, and Penrice Soda in working towards improved environmental outcomes.

The following recommendations have been made for the benefit of the Client and Stakeholders to assist with their assessment of various management options. Our recommendations are based upon and relate to specific investigations undertaken and knowledge gained during the course of this Study. A comprehensive response to the findings of this Study will integrate social, political, economic, and environmental values and involve considerations that are outside the terms of reference for this Study. Thus these recommendations should be seen as one component of the overall response-formulation process.

Recommendation #1

As a matter of priority, steps must be taken to reduce the volumes of wastewater, stormwater, and industrial inputs into Adelaide's coastal environment. This should be done within the context of an overarching strategy designed to remediate and protect the metropolitan coastal ecosystem.

Recommendation #2

The total load of nitrogen discharged to the marine environment should be reduced to around 600 tonnes (representing a 75% reduction from the 2003 value of 2400 tonnes).

Recommendation #3

Commensurate with efforts to reduce the nitrogen load, steps should be taken to progressively reduce the load of particulate matter discharged to the marine environment. A 50% load reduction (from 2003 levels) would be sufficient to maintain adequate light levels above seagrass beds for most of the time. The reduced sediment load will also contribute to improved water quality and aesthetics.

Recommendation #4

To assist in the improvement of the optical qualities of Adelaide's coastal waters, steps should be taken to reduce the amount of CDOM (coloured dissolved organic matter) in waters discharged by rivers, creeks, and stormwater drains.

Recommendation #5

While the available data suggests that toxicant levels in Adelaide's coastal waters pose no significant environmental risk, loads from point sources such as the Port River, WWTPs, and drains should continue to be reduced. Routine monitoring of toxicant loads and concentrations should be undertaken every 3-5 years.

Recommendation #6

Develop and implement a comprehensive and integrated environmental monitoring program that will enable natural resource managers and all stakeholders to evaluate changes in the coastal marine environment over time and at various spatial scales.

Recommendation #7

Maintain and develop the comprehensive data base of historical inputs generated by this study. It is suggested that a single entity be created to oversee the administrative functions associated with data collection, storage/retrieval, analysis, and reporting. This entity should also assume responsibility for the on-going maintenance and application of the various models produced by the ACWS so as to ensure that they remain both relevant and accessible. Consideration should also be given to the establishment of a research/monitoring coordination body. A primary function of this body would be to prioritise on-going and future research activities and to seek and allocate funding in accordance with those priorities.

Recommendation #8

Implement a long-term monitoring program to assess seagrass quality (or 'health') at sites adjacent to land-based discharges and at suitable reference sites.

Recommendation #9

Implement a long-term monitoring program of the outer depth margin of Posidonia *meadows in Holdfast Bay.*

Recommendation #10

Implement a long-term monitoring program of seagrass meadow fragmentation at a range of sites in Holdfast Bay.

Recommendation #11

Undertake detailed mapping of the distribution of Amphibolis *across the Adelaide metropolitan area, determine the lower depth limit of seagrasses in Holdfast Bay, and map seagrasses in the southern metropolitan area between Seacliff and Sellicks Beach.*

Recommendation #12

Undertake a spatially intensive nitrogen stable isotope survey to determine the offshore and northern extents of nitrogen influence from WWTP and industrial outfalls along the Adelaide metropolitan coastline, and also characterise nitrogen stable isotope signatures of potential nitrogen sources.

Recommendation #13

Undertake an audit of key environmental assets in the southern metropolitan coastal region, identify risks to those assets, and develop an integrated management plan to mitigate the risks. The applicability of management actions developed in response to the findings of this study to halt and reverse ecosystem degradation in the northern regions should be investigated with a view to adopting it (possibly with modification) in the southern region.

Recommendation #14

Adelaide's coastal marine environment must be managed as a component of a system that integrates catchment management, urban and rural land use, demographics, urban and industrial development, climate change/climate variability, and water re-use.

6 DIRECTIONS FOR FUTURE RESEARCH

While the ACWS has added considerably to our knowledge and understanding of the processes associated with coastal water quality, sediments, and seagrass, gaps inevitably remain. Areas for future research include:

- Experimentally test and model the combined effects of increased nutrients and turbidity on *Amphibolis* and *Posidonia*.
- Determine the photosynthetic parameters required for input to light-productivity models of *Amphibolis* and *Posidonia* off the coast of Adelaide.
- Conduct a spatially intensive $\delta^{15}N$ survey to determine the offshore and northern extents of nitrogen influence from WWTP and industrial outfalls in the ACWS region, and also characterise $\delta^{15}N$ signatures of potential nitrogen sources.
- Undertake further research on the basic biology of *Amphibolis*, which appears to be a crucial, yet sensitive, component of near-shore seagrass systems in Gulf St Vincent.
- Undertake further field research on the effects of increased nutrients in different locations/depths and in conjunction with decreased light (a proxy for increased turbidity).
- Undertake research on rates of meadow expansion and recolonisation in denuded and fragmented areas.
- Undertake research on sediment re-suspension and impacts on seagrass health.
- Undertake further research to refine nutrient budgets, determine denitrification processes, and develop a nutrient mass-balance model of Gulf St Vincent.
- Undertake more detailed research on the exchange between the Gulf and the adjacent Port River and Barker Inlet. This also requires a careful monitoring of water quality in this region during both summer and winter. The effects of reduced light levels on water quality and seagrass health associated with turbidity events in the near-shore zone need to be examined.
- Extend the investigation of physical processes that result in 'blowouts' in certain deeper water areas. This will require the determination of the physical sediment properties that can be used to define critical bed-shear stresses for mobilisation and transport and the use of models to provide spatial distribution maps of occurrences of bed-shear stresses resulting from the combined action of waves and currents (tide/wind).

7 MONITORING AND MANAGEMENT

Details of a suggested integrated monitoring program for Adelaide's coastal waters can be found in Technical Report 19 *An Integrated Environmental Monitoring Program for Adelaide's Coastal Waters*. A summary of the main components is provided in the following sections.

7.1 Seagrass Monitoring

The focus of seagrass monitoring is to determine the health, the distribution of species, and the extent of seagrass meadows. It is important that the protocols for monitoring seagrass are consistent with seagrass monitoring in other parts of South Australia to facilitate meaningful future comparisons.

Fixed sites

Regular summer or autumn monitoring of health indicators in fixed quadrats should be undertaken at specifically chosen sites, which is a cost-effective way to assess seagrass health. Photographs of quadrats would provide a quick and useful record for future comparison.

Permanent markers

Permanent markers, such as brass rods, should be placed at the inner and outer edge of seagrass extent; subsequent measurement of the recession or growth from those markers is a simple and cost-effective method for assessing change to the seagrass extent.

Diver transect surveys

Transect surveys by divers are a valuable component of the seagrass monitoring program because they provide an assessment of the distribution and composition of the seagrass community over a wider area than quadrat sampling.

Video sampling

Video sampling is a cheap and inexpensive way of surveying relatively large tracts of seagrass meadows.

Aerial photography

Aerial photography is an effective way of assessing broad-scale changes to seagrass extent and distribution. It is also the best link to the past monitoring activity in the region (approximately 5-yearly aerial photographs have been taken since 1949, although not all are useful).

7.2 Sediment Stability

The SA DEH Coastal Protection Branch undertakes substantial monitoring of sediment stability in Adelaide's coastal waters. The proposed ongoing monitoring for sediment stability is an extension of the existing monitoring program. The only additions and modifications suggested is to review the location of the current profile/ rod lines with a view to (i) extending some to coincide with key seagrass areas, and (ii) increasing the number of lines in the southern region.

7.3 Terrestrial Inputs

Impacts from land-based sources to the coast are most pronounced in Zones 1, 2, and 3 (Figure 4) and are generally well represented by existing monitoring of wastewater and stormwater.

It is recommended that water quality sampling of the receiving waters around the Bolivar outfall be monitored to capture any WWTP-related change. Similar sampling is already carried out in the receiving waters for the Glenelg and Christies Beach WWTP outfalls. It is also recommended that better estimates of stormwater loads be obtained for catchments that are presently not well quantified. This is particularly true of outlets away from the non-metropolitan area. For example, Field River does not have flow-proportional sampling. It is also suggested that dissolved organic carbon (colour) and turbidity of outputs from major stormwater outlets be regularly recorded given the potential effect these parameters might have on the light climate. Detailed monitoring of terrestrial inputs in the southern part of the study region is identified as important (given the likely population growth in that area and the objective of protecting existing seagrass). Atmospheric and groundwater inputs to Adelaide's coastal waters are a lower priority monitoring objective, since the contributions from these sources represents a small proportion of the total.

7.4 Coastal Water Quality

Water quality is a critical component of coastal health and is an essential component of any on-going monitoring program. The recommended monitoring of receiving waters of WWTPs, Port Adelaide River/Barker Inlet and the survey (Recommendation #12 of this report) have obvious implications for coastal water quality and should be considered simultaneously.

The existing SA EPA ambient water quality monitoring program is undertaken at 10 sites along the metropolitan coast (mostly jetties) and has a baseline monthly sampling intensity, which is increased to fortnightly during the summer months. This monitoring is necessary for compliance reasons and also informs decisions on the suitability of water quality for recreational activities. It also provides a valuable measure of the water quality after inputs to the coast are mixed and of how fine sediment is resuspended during windy weather. This gives an indication of the water quality that seagrasses in the near-shore zones are likely to experience. The parameters measured as part of the jetty sampling include turbidity, heavy metals, and bacterial counts. Nutrients are not measured since they are rapidly assimilated within the marine environment.

There is a need to regularly monitor water quality further offshore in the areas of existing seagrass meadows, and where seagrass re-colonisation is thought possible, because that constitutes a more direct measurement of the water quality which will ultimately determine the seagrass survival.

7.5 Physical Processes

Physical processes have an important effect on Adelaide's coastal waters. The hydrodynamics of the region affect the transport, mixing, and deposition of sediment and contaminants. Any changes to these processes may have implications for seagrass, sediments, and water quality; therefore monitoring of these processes is deemed necessary so that: (i) any shift to a new state (e.g. as a result of climate change/variability) is identified and the effects on coastal dynamics determined; and (ii) parameters of physical models be updated. It is recommended that the model developed as part of this study be updated annually.

It is essential to maintain access to wind, wave height, tide height, and storm records as these will help inform the processes of interest.

A regular broader refinement of the entire hydrodynamic model should be considered every 5–10 years in response to the collection of additional data and knowledge. This will ensure that the model continues to remain relevant and is providing information on appropriate spatial and temporal scales.

10 REFERENCES

ANZECC/ARMCANZ (2000). Australian and New Zealand Guidelines for Fresh and Marine Waters. National Water Quality Management Strategy Paper No 4, Australian and New Zealand Environment and Conservation Council/ Agriculture Resource Management Council of Australia and New Zealand, Canberra.

Dennison, W.C. and Abal, E.G. (1999). Moreton Bay Study: A Scientific Basis for the Healthy Waterways Campaign. South East Queensland Regional Water Quality Management Strategy, Brisbane, 246 p.

Harris, G., Batley, G., Fox, D., Hall, D., Jernakoff, P., Molloy, R., Murray, A., Newell, B., Parslow, J., Skyring, G., and Walker, S. (1996). Port Phillip Bay Environmental Study Final Report. CSIRO Australia.

Lewis S.A. (1975) Gulf St. Vincent Water Pollution Studies 1972–1975. Report of the committee on the effects of land-based discharges from metropolitan Adelaide upon the marine environment of Gulf St Vincent. Engineering and Water Supply Department, South Australian Government. EWS 75/14.

Lord, D.A. and Hillman, K. (1995). Perth Coastal Waters Study Summary Report. Water Corporation of Western Australia, Leederville, Western Australia.

Nayar, S., Collings, G., Miller, D., and Bryars, S. (2006). Nutrient fluxes in the meadow forming seagrasses *Posidonia* and *Amphibolis* from the Adelaide metropolitan coast. ACWS Technical Report No. 13 prepared for the Adelaide Coastal Waters Study Steering Committee. South Australian Research and Development Institute (Aquatic Sciences) Publication No. RD01/0208-18, Adelaide.

Ralph, P.J., Tomasko, D., Moore, K., Seddon, S., and Macinnis-Ng, C.M.O. (2006). Human impacts on seagrasses: Eutrophication, sedimentation, and contamination. In: Larkum, A.W.D., Orth, R.J., and Duarte, C.M. (eds), *Seagrasses: Biology, Ecology and Conservation*, Springer, Dordrecht, Netherlands, pp. 567-593.

Romero, J., Lee, K.S., Pérez, M., Mateo, M.A., Alcoverro, T. (2006). Nutrient dynamics in seagrass ecosystems. In: Larkum, A.W.D., Orth, R.J., and Duarte, C.M. (eds), *Seagrasses: Biology, Ecology and Conservation,* Springer, Dordrecht, Netherlands, pp. 227-254.

Webster, I. and Harris, G.P. (2004). Anthropogenic impacts on the ecosystems of coastal lagoons: modelling fundamental biogeochemical processes and management implications. *Marine and Freshwater Research* 55, 67-78.

Glossary

Acute: Severe and short lived

Aerobic: Presence of free oxygen in a chemical process

Algae: Large group of non-flowering plants, many microscopic, generally containing chlorophyll. Most algae are aquatic

Algal bloom: Microalgae occurring in dense numbers in a water body, as a result of favourable conditions (i.e. nutrient enrichment)

Ambient: The prevailing environmental situation. Sometimes called 'background'

Ammonia: Compound consisting of a single nitrogen atom coupled with three hydrogen atoms. It is a nitrogen source for algae

Ammonium: The positively charged cation formed when ammonia is neutralised. It is a nitrogen source for algae.

Anaerobic: A process conducted in the absence of free oxygen

Anthropogenic: Changes resulting from human activities

Anoxic: Devoid of oxygen

ANZECC: Australian and New Zealand Environment and Conservation Council

Bathymetry: Depth characteristics of a water body

Benthic: Belonging to the sea floor

Benthos: Organisms living on or in association with the sea floor

Bioaccumulation: Concentration of substances (especially toxicants) in the tissues of plants and animals

Biochemical: Chemical reactions occurring in living organisms

Biodiversity: Measure of the number of species inhabiting a given area

Biomass: The living weight of animal or plant populations or communities

Biota: All living organisms of a region

BP: Before present

Catchment: The area of land from which runoff from rain enters a waterway

Chlorophyll: Green pigments of plants, which capture and use energy from the sun to drive the photosynthesis process

Chronic: Over a long portion of the organism's life span. Less severe and generally over a longer time span than 'acute'

Conductivity: Electrical conductivity – the capacity of water to conduct electrical current; used to measure level of salinity

Denitrification: Conversion of bound nitrogen to elemental (gaseous) form

Density current: Movement of lighter (less dense) water over denser water

Detection limit: Minimum level of quantification for a particular analytical method

Diffusivity: A measure of the rate at which properties mix or spread out in all three dimensions

Ecology: The relationship of living things to their environment

Ecosystem: A community of plants or animals or both

Eddy: A rotating or whirling movement of air or water

Effluent: An outflow, usually sewage or wastewater

Eutrophic: Having an unnaturally high content of algae due to excess nutrients

Eutrophication: leading to a eutrophic condition

Fauna: All kinds of animals

Flora: All kinds of plants

Flushing: The rate at which a lake or bay changes its water content

Flux: Flow of material

Geochemical: Relating to earth chemistry

Geology: The study of earth processes

Geomorphology: The study of land forms

Groundwater: That part of rainfall which seeps into the ground and moves slowly in a horizontal direction

Gyre: A large eddy

Guideline values: Values (often concentrations) thought to represent safe conditions and chosen as a result of available research

Habitat: The place where a plant or animal lives

Heavy metals: A general term for cadmium, chromium, copper, iron, mercury, nickel, manganese, lead, zinc, arsenic, and selenium

Hydrocarbons: Compounds of hydrogen and carbon such as petroleum

Hydrodynamic: Related to movement of water

Indicator species: Animals or plants which indicate an effect or impact. e.g. pollution or loss of habitat

Infauna: Fauna that lives within benthic sediment

Inputs: Substances entering a water-body

Macroalgae: Large algae, in this report used to describe kelps and larger seaweeds

Mesotrophic: Water body that has moderate nutrient and algal levels.

Meteorology: The study of climate and weather

Microalgae: Single-celled plants. Less than 1/10th millimetre in length or diameter

Model: Mathematical equation or series of equations that provides simplified description of system or situation devised to facilitate calculations or predictions. With use of a computer, can provide simulation of large-scale environmental processes, e.g. hydrodynamic model

Monitoring: Continuous measurement

Nitrate: The NO_3 anion

Nitrification: Formation of nitrate from reduced forms of nitrogen

Nitrite: The NO_2 anion

Nutrients: Substances (e.g. nitrogen and phosphorus in various forms) required for the growth of plants (like fertiliser)

Oceanography: The study of oceans

Oligotrophic: Water body that has low nutrient and algal levels

Organism: A living entity of any size, plant or animal

Organochlorines: Complex organic molecules with chlorine atoms attached (e.g. many pesticides)

Organophosphates: Group of pesticides chemicals containing phosphorus, which are intended to kill insects

Oxic: Having oxygen present

PAHs: Polycyclic aromatic hydrocarbons. A class of organic chemical compounds many of which are known or suspected carcinogens

PAR: Photosynthetically active radiation. The spectrum of light required by plants for photosynthesis

Particulates: Particles suspended in water

PCB: Polychlorinated biphenyls – a class of organic compounds used as cooling and insulating fluids. Banned in the 1970s due to high toxicity

pH: The negative logarithm of the hydrogen ion concentration; an index of acidity or alkalinity

Photosynthesis: Transformation of carbon dioxide and water to organic matter and oxygen by means of light energy

Phytoplankton: Microalgae that live in the water column

Plume: In oceanography a term applied to a recognisable outflow into a receiving water body (e.g. Torrens River plume)

Pollutant: A substance in excess or not belonging

POPs: Persistent organic pollutants. Toxic chemicals (e.g. PCBs) that persist in the environment and animals. POPs pose a risk of causing adverse effects to human health and the environment

Receiving waters: Waters that receive effluent from a particular source

Residence time: The nominal time spent by a substance in a water body subject to tidal exchange or river flushing

Salinity: The salt content of seawater

Seagrass: A group of flowering plants which live rooted in the sea floor

Sediment: Any solid material which sinks to the bottom

Sewage: Strictly speaking household waste but loosely applied to any waste sent to atreatment plant

Stormwater: Runoff during storms

Stratification: Layering, usually due to temperature or salinity differences

Substrate: A surface on which organisms live or a substance serving a biochemical reaction

Suspended matter: See particulates

Suspended solids: See particulates

Terrestrial: Of the land

Tides: The movements of water in the ocean in response to gravitational pull of the moon and sun. As the earth turns the tides perform a daily cycle. Because the moon revolves around the earth the tides also undergo a lunar monthly cycle. The revolving of the earth around the sun imposes an annual cycle. All show up as high and low water levels

Topography: Mapping of land features

Toxic: Poisonous

Toxicant: A poison

Toxicity: Level or concentration of toxicant to create a toxic response

Turbidity: Cloudiness

Wastewater: Water that has been used and discarded. Not strictly the same as sewage

Wastewater Treatment Plant (WWTP): A place where human and industrial wastes are treated before disposal to land or water:

- **Primary treatment:** Screening the solids from the water and allowing organic matter and suspended solids to settle. This treatment typically removes one-third of the BOD and two-thirds of suspended solids

- **Secondary treatment:** Achieves stabilisation of biodegradable material through biological degradation. This treatment typically removes 85–90% of the BOD

- **Tertiary treatment:** Typically removes nutrients (nitrogen and phosphorus) and the remaining small volume of organic matter and organisms



The Adelaide Coastal Waters Study is an initiative of the South Australian Government and involved a number of Stakeholders from Government agencies, industry, and community groups. Its primary focus was on knowledge generation to improve our understanding of key coastal ecosystem processes to better inform sustainable management of Adelaide's coastal marine environment. The research phase of the study was undertaken between 2003 and 2006 and involved research teams and individuals from South Australia and other state universities, research organisations, and private consultants. The study was managed by CSIRO's Environmental Project Office.

Technical Report

Adelaide Coastal Waters Study

Stage 2 *Research Program 2003 - 2005*

Technical Report No. 12 July 2006

Turbidity and reduced light responses of the meadow forming seagrasses Amphibolis *and* Posidonia*, from the Adelaide metropolitan coastline.*

Government of South Australia

WaterCare
It's in your hands

CSIRO



Turbidity and reduced light responses of the meadow forming seagrasses Amphibolis and Posidonia, from the Adelaide metropolitan coastline.

Authors

Collings, G., Miller, D., O'Loughlin, E., [1]Cheshire, A., and Bryars, S.

South Australian Research and Development Institute
SARDI Aquatic Sciences
PO Box 120 Henley Beach
SA 5022

[1] SMU Pty Ltd, 33 Winding Way, Belair, South Australia

Copyright

© 2006 South Australian Environment Protection Authority

This document may be reproduced in whole or in part for the purpose of study or training, subject to the inclusion of an acknowledgement of the source and to its not being used for commercial purposes or sale. Reproduction for purposes other than those given above requires the prior written permission of the Environment Protection Authority.

Disclaimer

This report has been prepared by consultants for the Environment Protection Authority (EPA) and the views expressed do not necessarily reflect those of the EPA. The EPA cannot guarantee the accuracy of the report, and does not accept liability for any loss or damage incurred as a result of relying on its accuracy.

ISBN 1 921125 12 8

24th August 2006

Reference

This report can be cited as:

Collings, G., Miller, D., O'Loughlin, E., Cheshire, A., and Bryars, S. (2006) *Turbidity and reduced light responses of the meadow forming seagrasses Amphibolis and Posidonia, from the Adelaide metropolitan coastline*. ACWS Technical Report No. 12 prepared for the Adelaide Coastal Waters Study Steering Committee. South Australian Research and Development Institute (Aquatic Sciences) Publication No. RD01/0208-17, Adelaide.

Acknowledgement

This report is a product of the Adelaide Coastal Waters Study. In preparing this report, the authors acknowledge the financial and other support provided by the ACWS Steering Committee including the South Australian Environment Protection Authority, SA Water Corporation, the Torrens Patawalonga and Onkaparinga Catchment Water Management Boards, Department for Transport Energy and Infrastructure, Mobil Refining Australia Pty Ltd, TRUenergy, Coast Protection Board and PIRSA. Non-funding ACWS Steering Committee members include the Conservation Council of SA, SA Fishing Industry Council Inc, Local Government Association, Department of Water Land and Biodiversity Conservation and Planning SA.



SARDI Aquatic Sciences Disclaimer

The recommendations given in this report are based on the best available information at the time of writing. The South Australian Research and Development Institute (SARDI) makes no warranty of any kind expressed or implied concerning the use of the information contained in this report.

Printed in Adelaide August 2006

SARDI Aquatic Sciences Publication Number RD01/0208-17

SARDI Research Report Series Number 153

ISBN Number

Authors: Collings, G., Miller, D., O'Loughlin, E., Cheshire, A., and Bryars, S

Reviewers: T. Kildea, R. Wear

Approved by: Dr Tony Fowler

Signed: 

Date: 24 h August 2006

Distribution: ACWS Scientific Committee, ACWS Steering Committee, SARDI Aquatic Sciences Library

Circulation: Public Domain

Acknowledgements

The authors thank Bruce Miller-Smith, Sasi Nayar, Mandee Theil and Yvette Eglinton for their assistance in undertaking the experiments presented in this document. Suzanne Bennett is also thanked for assisting in the preparation of this document. This research has been funded as part of the Adelaide Coastal Waters Study. Thanks also to Dr Stephanie Seddon who was instrumental in the development of the original Task EP1 proposal. Thanks go to Professor Peter Fairweather and Dr Bronwyn Gillanders for guidance and intellectual input to Task EP1. Also, we thank Dr Jeremy Wilkinson and Assoc Prof Howard Fallowfield for assistance with coastal input information and useful references. Thanks to staff at SA Water and the EPA for their assistance in gathering information used in this document. Dr Jason Tanner, Tim Kildea and Rachel Wear provided useful feedback on a draft document through SARDI Aquatic Sciences' internal review process. We acknowledge the financial support of the stakeholders in the Adelaide Coastal Waters Study and intellectual input from the ACWS Steering Committee and ACWS Technical Review Committee.

Table of contents

1. Executive overview 3

2. Introduction 5

3. Materials and Methods 11

3.1. Light Environment 11
3.1.1. Field Deployment 11
3.1.2. Calculation of Subsurface Light 12
3.1.3. Modelling missing data 14
3.1.4. Calculations 15

3.2. Productivity Modelling 16
3.2.1. Scenario 1 – Effect of altering photokinetic parameters (sensitivity analysis) 18
3.2.2. Scenario 2 - the effect of variable optical water quality 18
3.2.3. Scenario 3 - the effect of light field variability on productivity 21
3.2.4. Scenario 4 – The application of literature photokinetic parameters 21

4. Results 23

4.1. Light Environment 23

4.2. Productivity Modelling 30
4.2.1. Scenario 1 – Effect of altering photokinetic parameters (sensitivity analysis) 30
4.2.2. Scenario 2 - the effect of variable optical water quality 32
4.2.3. Scenario 3 - the effect of daily light field variability on productivity 33
4.2.4. Scenario 4 - The application of literature photokinetic parameters 34

5. Discussion 39

6. Conclusions and further directions 47

7. References 49

1. Executive overview

It has been proposed that poor optical quality of the water body may be detrimental to the productivity of seagrasses, and that this may explain the loss of seagrass from the Adelaide metropolitan coast. In order to test this hypothesis, light was continuously recorded by light meters placed at depths of 3, 6, 12 and 18 metres off the coast of Grange. Seagrass beds in this region extend from 5 to 18 m depth.

Calculation of attenuation coefficients indicated that optical water quality was extremely poor in the nearshore region, particularly the 3 m and (to a slightly lesser extent) the 6 metre site. Beyond this, optical water quality improved. This is indicative of plumes of turbidity being entrained in the nearshore region, a feature which is consistent with the water movement modelling conducted as part of the ACWS project.

Despite the poorer water quality, the fact that the nearshore regions are shallower results in a greater amount of light reaching the seafloor at the three metre site on an annual basis than at other sites. This refutes the simple hypothesis that lower light levels in the nearshore region were responsible for seagrass loss, as regions further offshore support seagrass despite lower levels of light.

The higher average levels noted at the inshore sites were the result of only five months of elevated light. During the period June to December, poor optical water quality reduced light at these inshore sites to the same level as those at 18 metres (which should have been far lower because of their greater depth). Reduced light levels were strongly associated with the discharge of land-based inputs to the coastal zone.

The current nearshore light conditions probably do not represent the worst conditions that have been experienced. When the initial losses occurred in these seagrass beds, periodic turbidity events were probably more pronounced because the buffering influence of the Kangaroo Creek reservoir did not exist at this stage. Ameliorating this beneficial effect, however, is the fact that lost seagrass has decreased sediment stability, thereby increasing turbidity.

The hypothesis that seagrass loss in the inshore region is due to a poor light climate is based on the fact that light drives photosynthesis, and if photosynthesis is not adequate to provide enough energy to balance the needs of metabolic processes and growth, then the plant can not survive in the long term. If light were linearly related to productivity, then the demonstration of higher light levels would refute the hypothesis. However, the relationship between productivity and light is complex and non-linear. Therefore, an attempt is made to estimate productivity using a modelling approach to address the possibility that productivity might be limiting despite higher average daily irradiance.

The modelling has demonstrated that greater variability in the light field, as has been measured in the nearshore region in the current study, has a detrimental effect on productivity. Thus, variability of light field, which is a function of the turbidity introduced from land-based sources, may provide an explanation for the disappearance of seagrass from the nearshore region.

To investigate this possibility, the productivity model was parameterised using productivity – irradiance relationships derived from the literature and the irradiance measured from the Adelaide metropolitan coast. This model was able to demonstrate an annual nett productivity which was lower at three metres than at any other depth. Considering that one of those depths represented the deep margin of the bed, a boundary generally considered to represent the point where productivity is barely sufficient for plant maintenance, this supports the hypothesis that the light climate of the nearshore zone may not be suitable for seagrass.

While we cannot determine whether the light climate alone might be the cause of inshore seagrass loss , the possibility cannot be discounted on the basis of this work, and at the very least, this light climate will provide an extra stress on the seagrass.

2. Introduction

Since the 1940's, over 5200 ha of seagrass meadows have been lost from the Adelaide metropolitan coast (Seddon 2002). In particular, major losses of nearshore seagrasses have occurred in the region between Outer Harbour and Seacliff (Westphalen et al. 2005). Degradation and loss of seagrass meadows is a major cause of concern for coastal managers due to the importance of these systems to nearshore productivity, seabed stability, and biodiversity (Clarke 1987; Duarte and Chiscano 1999; Ruiz and Romero 2003). Seagrass losses along the Adelaide coast have previously been linked to the construction of stormwater drains, wastewater discharges, coastal developments, and the re-channelling of the Torrens River to the sea (Westphalen et al. 2005). Nonetheless, the primary causes of seagrass decline are poorly understood for the Adelaide metropolitan coast where seagrass loss has mainly occurred from the shallow inshore margin advancing seaward. Potential causes of seagrass decline along the Adelaide coast include elevated nutrients, toxicants, increased turbidity, and decreased salinity (see Westphalen et al. 2005 for a review). Potential toxicants include heavy metals, pesticides, herbicides, and petrochemicals. Erosion processes have also played a role in ongoing seagrass losses (Clarke 1987, Seddon 2002). Furthermore, Tanner (2005) reported the disappearance of deep-water seagrasses (*Zostera tasmanica*) from lower Gulf St Vincent between the 1970's and 2000/01, postulating that a possible cause of the losses was a long-term increase in turbidity due to coastal inputs from Adelaide.

Almost universally, the causes proposed for seagrass loss have been anthropogenic in nature (see Shepherd et al. 1989; Gabric and Bell 1993; Vermaat et al. 1996; Short and Wyllie-Echeverria 1996). As seagrasses are restricted to the narrow coastal margin, they are also particularly prone to land-based inputs, and therefore, the effects of man (e.g. Vermaat et al. 1996; Livingston et al. 1998; Bearlin 1999) Increased nutrients, decreased salinity, toxicants and decreases in the quantity of light are all likely to be concentrated in the area closest to the coast where rivers, which run through cities and agricultural land, terminate; where stormdrains end; where dredging occurs and where effluent outfalls are found (Phillips and Scholz 1982; Fourqurean et al. 2003). Whilst the rationale is to dilute these effects below the level of harm in the vastness of the sea, currents and weather patterns may resist such a dilution and entrain the effects within a much smaller region closer to the coast (Burt et al. 1995; Pattiaratchi and Jones 2005).

The Adelaide Coastal Waters Study has addressed a number of these potential stressors in an attempt to isolate which causes are likely to be responsible for the loss of seagrass which has occurred off the Adelaide coast since the 1940s. Of these, eutrophication appears to be an important factor, whilst salinity and toxicants have proven unlikely. This particular study represents an investigation of the likelihood that poor light conditions are responsible for seagrass losses in this area.

Light is critical to the survival of all photosynthetic organisms (Shepherd et al. 1989; Perez and Romero 1992; Best et al. 2001). It is the sole energy source of photosynthesis, which fixes carbon dioxide and water into carbohydrates and oxygen (Falkowski and Raven 1997). The accumulation of carbohydrates through photosynthesis represents gross productivity. Nett productivity is calculated by subtracting the continuous metabolic demands of the plant (i.e. respiration) from gross productivity.

Nett productivity may be negative, where the demands of respiration outweigh what can be supplied through photosynthesis i.e. more energy is required than is being supplied. This situation can be supported over a limited timeframe through the accumulation of reserves in times of high light which can be utilised when respiratory demands cannot be otherwise met

(Burke et al. 1996; Alcoverro et al. 2001; Holmer and Bondgaard 2001). The timescale of such a deficit is of critical importance. Over short timeframes, it is not an issue as evidenced by the fact that the natural cycle involves nighttime where respiration continues at approximately the same rate as during the day despite the lack of any light to drive photosynthesis. Over longer timeframes, storage organs such as the root biomass of seagrasses can act as a store of carbohydrates to be called upon during periods where insufficient light is available (Burke et al. 1996; Touchette and Burkeholder 2000; Cabello-Pasini et al. 2002). This has been suggested as a major mechanism for the survival of seagrasses across seasons where light levels would otherwise be too low and also as a mechanism to support survival when sedimentation results in burial (Clarke 1987).

Generally, it is accepted that the offshore (deep) margin of the seagrass bed defines the point where the amount of light received is only just sufficient to allow enough productivity to balance the carbon demands of the plant (Duarte and Chiscano 1999). Any deeper than this, and the consequent decrease in light dictates that productivity is unable to balance these demands. For this reason, a decrease in water clarity (which can be due to either or both of turbidity (suspended solids) and dissolved organic compounds) is likely to result in loss of seagrass in the deeper regions, where the added turbidity pushes light levels below a critical threshold (Duarte 1991). Thus the result of increased turbidity is often felt at the offshore margin of the seagrass bed (See also Masini et al. 1995a for a similar argument about the effect of epiphytes at the deep margin). Adelaide is unusual in that much of the loss of seagrass has occurred from the *nearshore* margin (Westphalen 2005). On first glance, this may seem inconsistent with the effects of decreased water clarity. However, there are two important factors relevant to this situation which need to be considered.

Firstly, it is possible, through the effects of wind and water movement, that the effects of the land-based discharges are entrained in a region close to shore rather than distributed evenly across the range of the seagrass. This could result in a situation where light levels were actually lower in the nearshore region despite the far shallower depth. Aerial photographs would support this hypothesis (see, for example Figure 1). The potential for entrainment due to wind and current driven water movement is addressed in the modeling exercises of Pattiaratchi and Jones (2005), where a clear case is made for this argument.

The second possibility revolves around the fact that light levels only tell half the story. Ultimately, it is not low light which is responsible for the loss of seagrass – it is the low levels of productivity which may be caused by poor light conditions (e.g. Alcoverro et al. 2001). Productivity is determined, not only by the amount of light, but also by the relationship between the level of irradiance and the amount of productivity.

The instantaneous rate of carbon fixation is dependent upon the ambient light. At low light levels, little carbon is assimilated, but as the light increases, this fixation rate increases. However, the relationship is typically asymptotic, with increasing light levels not resulting in as much increase in photosynthesis (i.e. carbon assimilation) when light levels are high (e.g. Cheshire et al. 1995, 1997). The relationship is known as the photosynthesis : irradiance (or "P:I") curve and is pictorially represented in Figure 7. It can be described relatively accurately with a knowledge of three key parameters: the maximal photosynthetic rate (P_{max}); the dark respiration rate (Rd); and the subsaturating light intensity (I_k). These are collectively known as photokinetic parameters.

Whilst plants can adjust their pigment systems to become more efficient where light levels are low, and it is commonly accepted that deeper plants make more efficient use of the available light, such adjustment has energy costs associated with it and is often slow. Furthermore, such adjustment is not infinitely possible. Thus there are critical limits to light, beyond which a plant is unable to adapt and cannot harvest enough energy to survive.

The shape of the P:I curve often varies across light regimes and species (Masini et al. 1995a; Major and Dunton 2002; Campbell et al. 2003). Typically, plants in deep water environments tend to be far more efficient harvesters of light than those in shallow waters because they need to be in order to achieve positive nett productivity (e.g. Titlyanov et al. 1992) with less available light. Conversely, shallow plants actually have a requirement to be relatively inefficient in their harvesting of light because the high light levels would cause photo-damage if they were not "de-tuned" (Lüder et al. 2002; Major and Dunton 2002). This means that despite having higher light levels on the nearshore margin, the inefficiency dictates that productivity is no higher. Furthermore, if that environment is highly variable on short timescales, then slow pigment system adaptation rates would render the plants less productive.

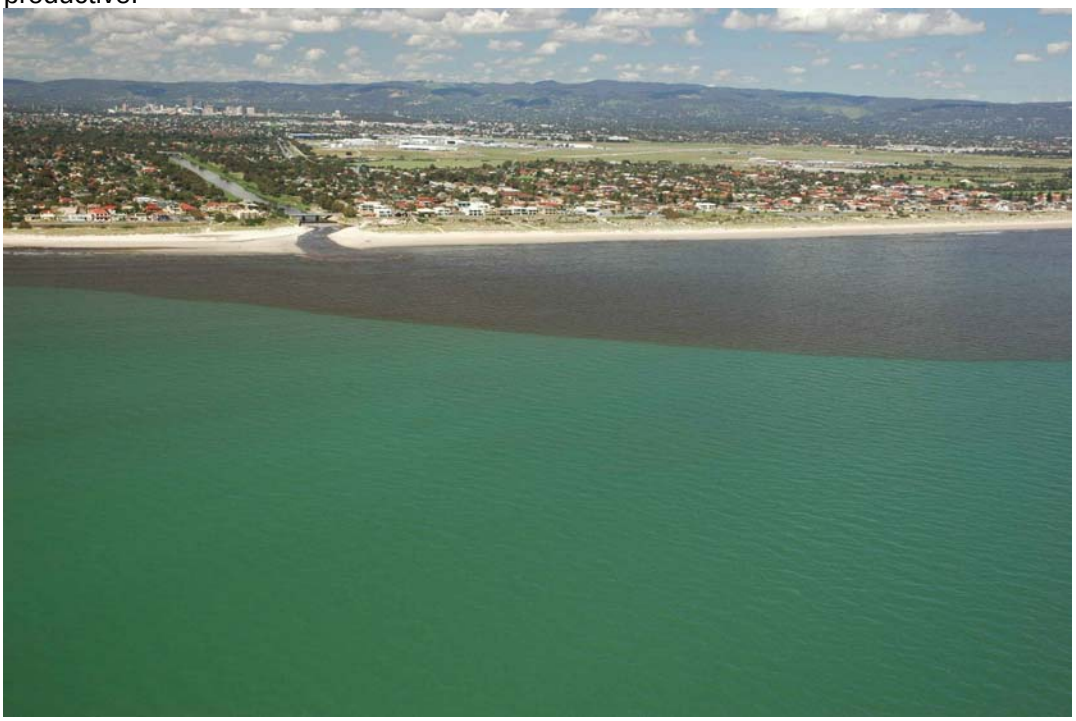


Figure 1: Major discharge of stormwater from the Torrens River into Adelaide's coastal waters on 25 October 2005. Dark region is increased turbidity. Photo: S. Bryars

In the absence of any definitive identification of the length of time across which nett negative productivity can be supported, and the large quantity of underground biomass which could assist in maintenance of respiration across extended periods, it seems likely that an annual cycle is an appropriate length of time over which to analyse the nett productivity of seagrasses. Importantly, such an extended period takes into account all the major fluctuations operating over the period likely to be of importance to the seagrass. In particular, changes across the course of the day are integrated, as are the seasonal changes associated with the sun angle and cloudiness of the atmosphere. Predictable seasonal changes also influence the average sea-state and the amount of runoff from land-based discharges. All of these changes are integrated by measuring light levels at the level of the seagrass canopy and producing productivity models which operate across an annual cycle. Anything less than that and the results are biased against any part of the annual cycle which has been missed. If that was a high light period, then the output would be likely to underestimate productivity, whilst if a low light period was missed, the productivity would be overestimated.

There are a number of approaches which can be taken to investigate the possibility that poor light climate may be responsible for the loss of seagrass on the Adelaide metropolitan coastline. However, most are plagued by the fact that seagrass loss has not been a rapid process – it has been a chronic decline, and as a result short term approaches to the investigation of stress are likely to be inappropriate, or at best we would be unsure of how much confidence to place on the results when extrapolated to an ecologically appropriate timescale. For instance, the work of Gaetjens (2005), using effective and maximum quantum yield as indicators of the effect of variable light levels is more suited to identifying an acute stress than identifying long term effects. Shading experiments have the effect of reducing the mean light intensity, but a laboratory or mesocosm scale experiment fails to replicate the natural variability in the light climate which may be very relevant to this situation. Shading in the natural environment was impractical as, apart from altering the hydrodynamic environment, it would have required more maintenance time than was available if the experiment was to be sufficiently long term. Thus, we directed energies toward constructing a high quality, intensive dataset across a complete annual cycle. With this data, we can construct models which predict productivity under a variety of scenarios. Within the constraints of this study, it was not possible to characterise the photosynthesis : irradiance relationship of the major species down a depth profile and across the annual seasonal cycle. However, data were available from published sources which could be used to at least construct a simple model which would indicate whether it was possible that light conditions were causing productivity levels which could explain seagrass decline. Furthermore, as more detailed information becomes available on the P:I relationship, we will be able to recalibrate and fine tune the model. It has also provided an excellent long term study of the light climate of the Adelaide coast which stands in its own right as a valuable description of an important feature of the marine environment of the Adelaide metropolitan coast.

With this approach in mind, we aimed to test the general hypothesis that the light climate was worse in the nearshore zone at three metres (from where seagrass beds have been lost) than at other sites further from shore where seagrass has not been lost. This was extended to include variability in the photokinetic parameters of the plants to investigate whether the light conditions could explain the loss of seagrass when depth-specific photokinetic parameters were utilized. There were five specific hypotheses to be tested:

1. That there was less photosynthetically active radiation at the nearshore site than further offshore. This would represent powerful evidence that the light climate may be responsible for productivity levels which were insufficient to support the seagrasses.

2. That the light climate was more variable at the nearshore site than further offshore. On the basis of the fact that plants are known to tune their photosynthetic apparatus (often slowly) to the ambient light conditions, large fluctuations in light may make this a difficult task.

3. That reduced light levels are caused by increased land-based runoff. This hypothesis investigates the likely cause of the light environment experienced by the Adelaide metropolitan coast.

4. That variability in light climate (without any change in mean levels) is disadvantageous for seagrasses on the basis of lower productivity. This puts Hypothesis 2 into the perspective of an effect on the plants. Whilst it does not answer the question of whether these conditions caused seagrass loss, it does indicate whether variability is inherently disadvanatageous to seagrasses by way of decreased productivity.

5. That the light climate of the Adelaide metropolitan coast produces conditions which, in the context of reasonable photokinetic parameters, explain the loss of seagrass from the nearshore zone of this region. Using modeling, we investigate whether a scenario can be produced which demonstrates poorer productivity for the nearshore site (which has lost its seagrass beds) than it does for other sites further offshore, yet still allows for lower productivity at the deeper edge (where productivity is marginal) than at intermediate sites (which support dense seagrass beds and are presumably relatively productive).

3. Materials and Methods

3.1. Light Environment

3.1.1. Field Deployment

A series of Odyssey photosynthetically active radiation (PAR) (400-700 nm) cosine type light meters (Dataflow Systems, New Zealand) were deployed off Grange at a range of depths on March 10th 2005, recording average light intensity for each half hour period. Each of these was attached to the top of a star picket with cable ties such that it sat 60 cm above the sand substratum to approximate the canopy height of an *Amphibolis* / *Posidonia* meadow. Meters were located at distances of 0.5, 1, 2.5 and 3.5 km from the shore in depths of 3.5, 6.5, 12.5 and 18.5 m (mean tide level; Figure 2). These are referred to as the 3, 6, 12 and 18 metre sites. The 3 m site was inshore of the nearshore seagrass edge, in the area from which seagrass has been lost. The 6 m site is just within the seagrass zone, and the 18 metre site is just within the seaward (deep) edge of the seagrass zone. The 12 m site was approximately 2/3 of the way to the deeper edge. Meters were retrieved and substituted on an approximately fortnightly basis in order to ensure that light readings were not affected by algal growth on the sensors.

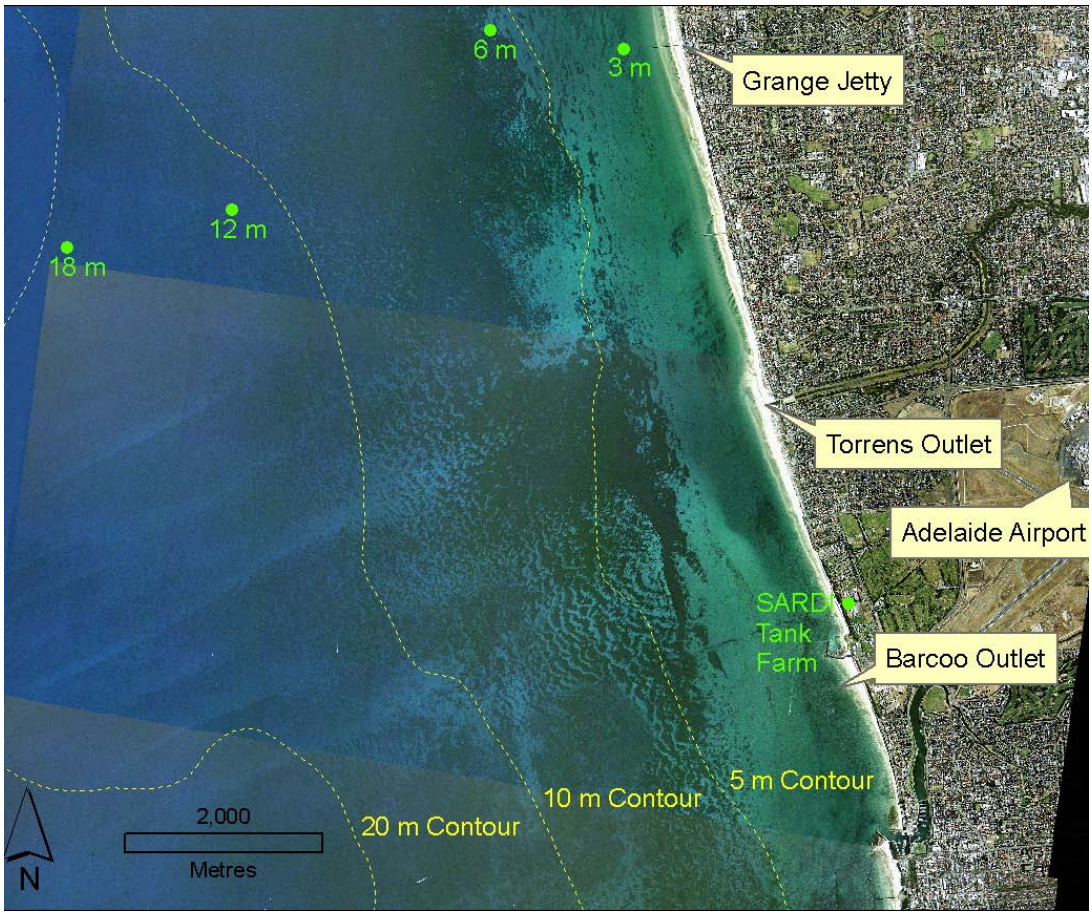


Figure 2: Aerial photograph showing the location of offshore submerged light meters off Grange, the West Beach (SARDI Tank Farm) surface light meter and Adelaide airport, where some values were obtained to replace data missing from the West Beach dataset. Some of the small northern area beyond the 20m depth contour is artificially coloured where no aerial photographs were available.

3.1.2. Calculation of Subsurface Light

Assessing optical water quality requires both a measurement of the light at the seafloor and at the surface in order to calculate how much has been cut out (absorbed) by the water column. The light measurement at the surface has to be just below the surface in order to take into account the fraction of light which is reflected from the sea surface. This is therefore termed a "subsurface" reading. However, subsurface light is difficult to measure in a long term field trial because waves and tidal movement will dictate that a fixed light meter will be submerged part of the time and in air at others. For this reason, subsurface light was calculated by measuring PAR with an Odyssey light meter in air at the SARDI Aquatic Sciences Tank Farm at West Beach and then applying a conversion factor which simulated the amount which would be reflected for any given sun angle.

The conversion factor applied to simulate the effect of reflection from the sea surface is dependent on sun angle, which in turn is dependent upon the latitude of the reading, the day of the year and the time of day. Only a small proportion is reflected unless the angle to the surface of the sea is quite acute (i.e. very early or late in the day). The relationship is demonstrated in Figure 3. Whilst the relationship assumes a flat reflecting surface, it is robust to the effects of waves on the surface (Angstrom 1925 in Kennish 1989).

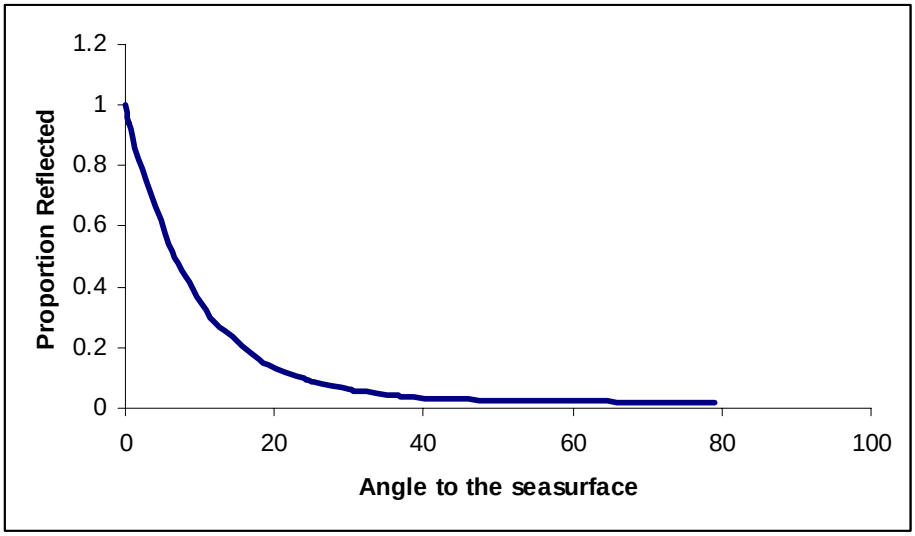


Figure 3: The effect of the angle of the sun on the amount of light reflected at the surface of the sea. Beyond an angle of 20 degrees, the majority of light is transmitted rather than reflected. This graph is derived from the reflectance model described below.

The equations used to determine the light transmitted immediately subsurface are:

1. Subsurface Irradiance = Surface Irradiance x (1 - Reflected Fraction)

2. Reflected Fraction = $\frac{1}{2} \times \left[\frac{\sin^2(i-r)}{\sin^2(i+r)} + \frac{\tan^2(i-r)}{\tan^2(i+r)} \right]$

where; i = angle of incidence and r = angle of refraction and are related by the formula;

sin(i) = 1.3398 x sin (r). (from Kennish 1989)

3. Angle of incidence (i) = $\sin^{-1}$[cos(H).cos(SD).cos(latitude)+sin(SD).sin(latitude)] where;
H (=Hour Angle) = 15° for each hour beyond solar noon and;
SD (=Solar Declination) = -23.45^{o}.cos((360/365).(N+10)) (N=days since Jan 1)

Equation 1 was used to determine the fraction of light lost to reflection at the sea surface (as opposed to being refracted and transmitted below the surface). Only when the sun angle was very low was there a marked reduction in the amount of light transmitted. This is demonstrated in figures 4 and 5. where the effect of time of day and day of year on transmittance are shown. Generally, after the first three of hours of the day and before the last three, the proportion of light transmitted was relatively high and constant (Figure 4). On a yearly basis, there was a reduction in the proportion of light transmitted toward the middle of the year, and this was more pronounced when the sun was low in the sky because of the time of day (Figure 5).

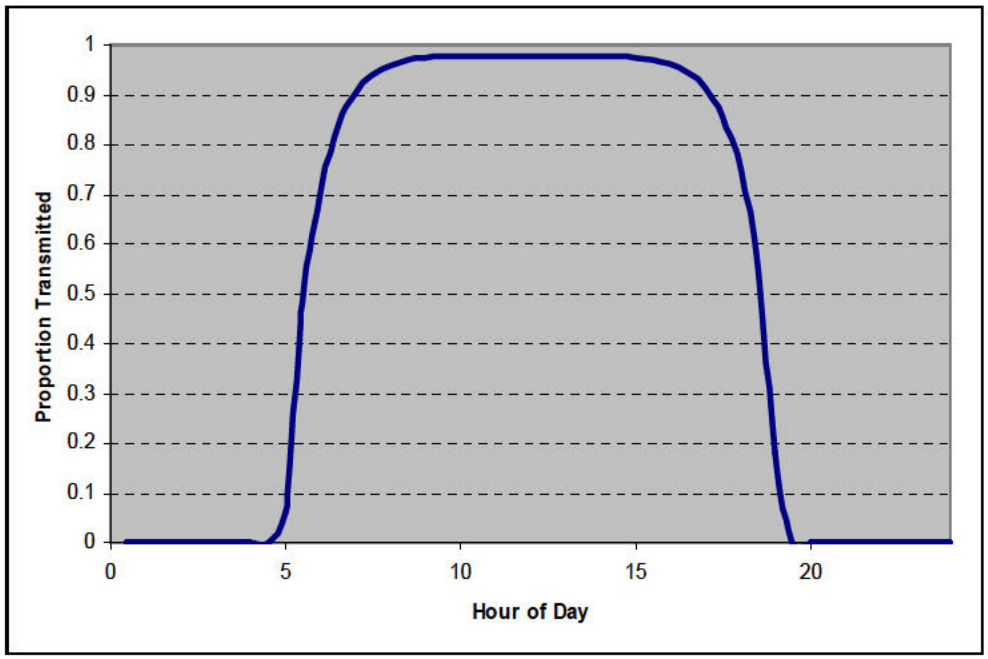


Figure 4: The modelled proportion of light transmitted below the surface of the water as a function of time of day. In this instance, the day demonstrated is January 1st. Other than very early and late hours of daylight, the angle of the sun is such that very little light is reflected and a large and relatively constant proportion of light is transmitted.

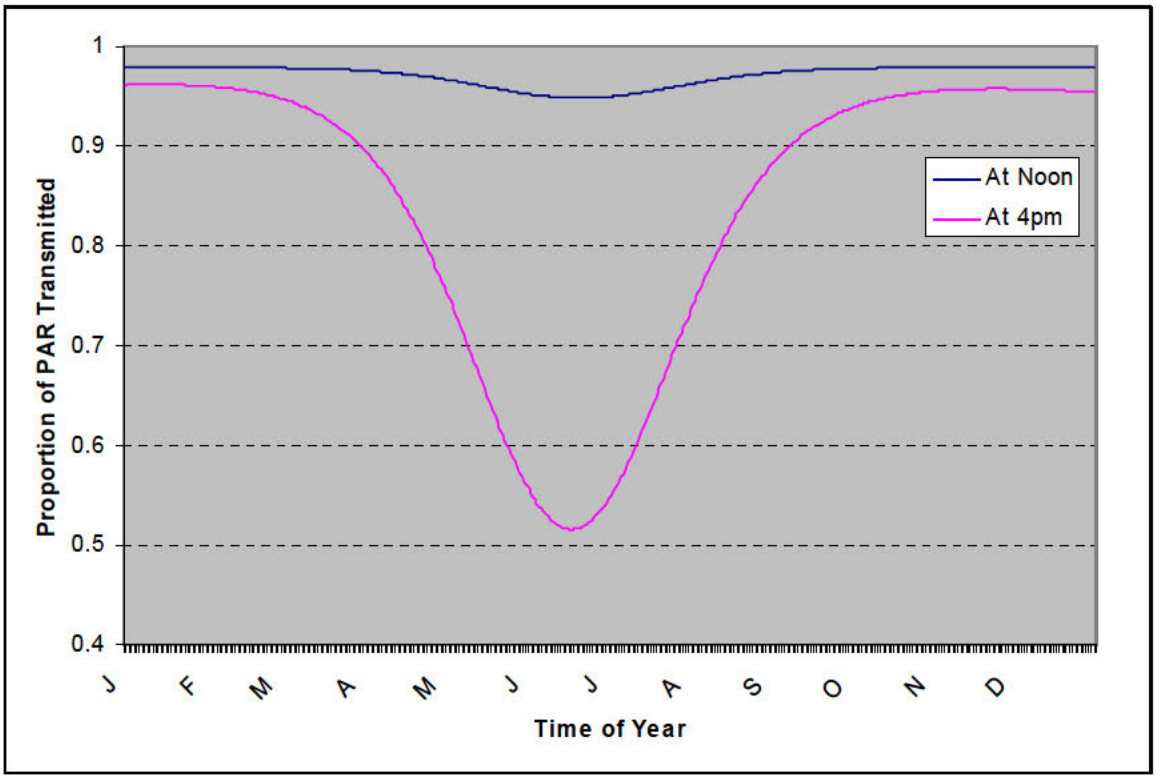


Figure 5: The modelled proportion of light transmitted below the surface of the water as a function of time of year and time of day. There is an increase in the amount of light lost to reflectance toward the middle of the year (winter). This is more evident at 4pm, when the sun angle is already low, than at noon.

3.1.3. Modelling missing data

Submerged Light

On occasion, because of problems with the light logging units, it was necessary to estimate appropriate values. For example, when light loggers were changed over, there was a period of an hour where the data might be dubious as there was a period during this time when both the new and replaced light metres were on deck, receiving full sun. For these periods, the values were modelled using the following formula:

$$Irradiance_{d,t} = Irradiance_{d-1,t} \times (Irradiance_{d,t-1} + Irradiance_{d,t+1}) / (Irradiance_{d-1,t-1} + Irradiance_{d-1,t+1})$$

where d indicates the day in question and d-1 indicates the previous day

t= the time requiring a modelled value; t-1 indicates the previous hour, t+1 the following hour

In essence, this creates a value based on the value at the same time on the previous day modified by the ratio of irradiance on the day in question to the previous day. Calculation of this ratio is based only on the hour either side of the time in question.

Surface Light

Where surface light readings were unavailable (approximately 7% of readings), they were modelled from half hour global insolation data recorded at Adelaide airport by the Bureau of Meteorology. By comparing daily total insolation as recorded by our loggers with that obtained from Adelaide airport over all periods where both were available, it was possible to calculate the ratio between the two for each month. This ratio was then applied to the airport data in order to model half hourly insolation as it would be recorded by our loggers. To check the validity of the approach, a month where data were available from both sources was used to produce a modelled light field. When compared to the actual data, the model produced an excellent fit (Figure 6). The r^2 value (Sum of Squares$_{model}$/Sum of Squares$_{actual}$) was 0.98, indicating that 98% of the variation in the real data was explained by the model. On this basis, it was concluded that the modelled data would be appropriate.

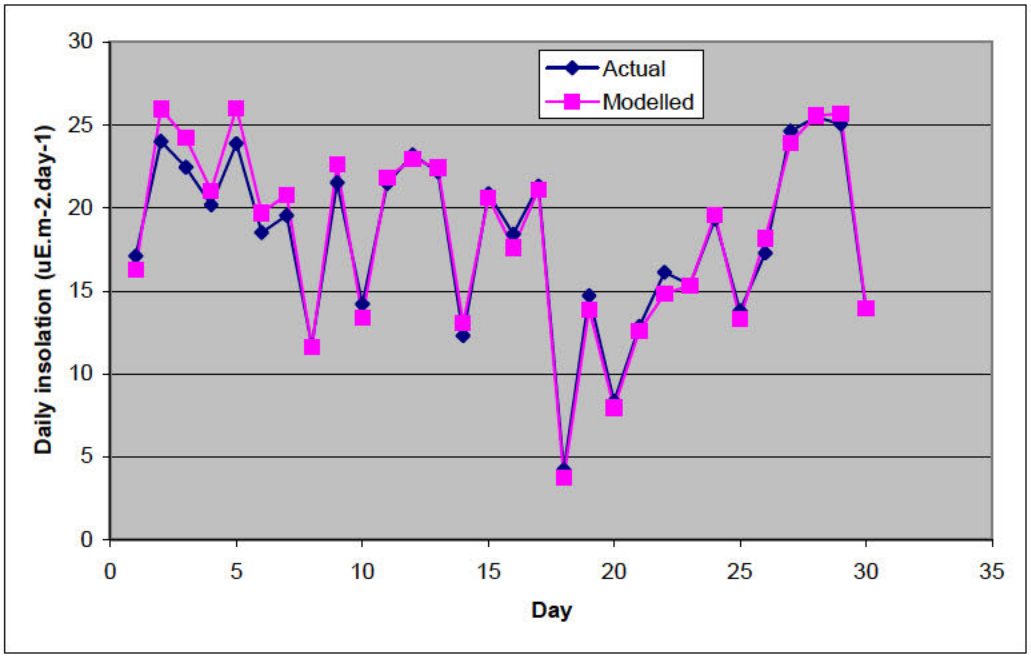


Figure 6: Fit of the modelled data against real data to test whether modelled data were appropriate for use where actual data were not available. r^2 was 0.98, indicating an extremely good fit.

3.1.4. Calculations

Half-hourly readings of average PAR intensity were provided by the loggers. These were summed and multiplied by 1800 to reflect the fact that the reading was expressed in μmol photons m^{-2} per second rather than per half hour. This provided readings for daily PAR dose which were then used to create monthly and yearly averages. In order to calculate the percentage of subsurface light lost to attenuation in the water column, the daily dose was calculated in the same way for the subsurface light (as calculated in section 3.1.2) and compared with the sum for the same day at the depth in question. It was calculated on the basis of the daily totals, rather than half hourly, because the geographic distance between the canopy level underwater meters (at Grange) and the meter measuring subsurface light (at West Beach) meant light conditions may not be comparable on a short timescale. Any short term differences in light should be integrated across the course of the day.

Variability in light field is calculated for each site in each month. In the first instance, this is done by simply calculating a) the range (maximum for month minus minimum for month) and b) the standard deviation of daily irradiances across the month. In recognition of the fact that the variability will naturally be associated with the mean, regardless of any influence of variable optical water quality, a third comparison is made where the standard deviations are calculated on the basis of light fields which have been standardised for the effect of the mean. This was done by calculating the mean daily irradiance for each site in each month, then standardising daily totals by the appropriate mean. Standard deviations for each month and depth were recalculated on the basis of these adjusted daily values.

3.2. Productivity Modelling

This section uses the annual irradiance dataset which has been collected for each site to investigate, in a comparative manner, the effects of certain characteristics of the light field on the productivity of seagrasses. In order to do so, it draws upon an understanding of the relationship between light levels and the productivity of the plant which is relatively incomplete and therefore makes numerous assumptions. Considerations such as seasonal changes in the photophysiology of the plant are not considered, and our understanding of the influence of light levels on these is also not well developed. Furthermore, what understanding we do have is derived from studies elsewhere. For this reason, the conclusions drawn from these modelling studies are therefore necessarily circumscribed by our confidence in these assumptions. This is not to say that we have no confidence in the conclusions, merely that the conclusions must be drawn in terms of comparison of various models (for example comparing productivity at different depths), rather than placing credence on an absolute value demonstrated by a single site and drawing conclusions from that.

The productivity of any photosynthetic organism is dependent upon the level of light which they are subjected to. However, this relationship is a complicated one, demonstrating a linear response at low irradiance levels, but tapering off to an asymptote at higher levels (Figure 7). Additionally, this response is not consistent between species (e.g. Masini et al. 1995a; Masini and Manning 1997; Cummings & Zimmerman 2003), nor within species where differences may occur according to environment; in particular light environment (e.g. Mazella and Alberte 1986; Masini et al. 1995a; Masini and Manning 1997) and temperature (e.g. Perez and Romero 1992; Touchette & Burkholder 2000).

Several mathematical models have been fitted to describe the relationship of productivity to ambient light conditions (Fourqurean and Zieman 1991, Falkowski and Raven 1997). Essentially each represents a line of best fit to describe productivity based on the ambient light and on certain parameters of the plant which describe the maximal productivity (P_{max}), efficiency at sub-saturating light intensities (I_K) and dark respiration (Rd).

For the purposes of our study, Chalker's (1981) model was utilised:

$$P_I = P_{\max} \times (1 - e^{(\frac{-I}{I_k})}) - Rd$$

where; P_I represents the nett productivity at a given level of illuminance, I;
P_{max} represents the gross maximum productivity;
I_K represents the subsaturating light level and,
Rd is the dark respiration rate

Chalker's (1981) model has been shown in many studies to provide a good fit to measured P-I data (e.g. Cheshire et al. 1995, 1997).

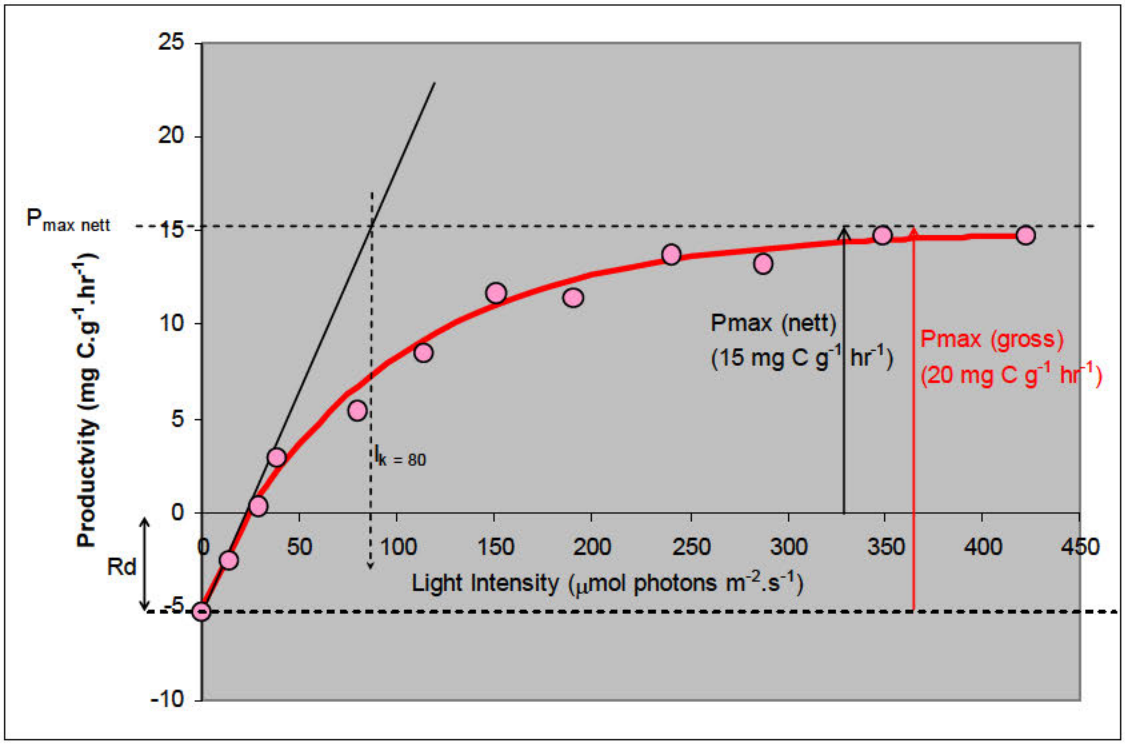


Figure 7: A typical Photosynthesis – Irradiance (P-I) curve showing productivity as a function of light intensity. Nett productivity at any light intensity represents gross productivity minus dark respiration (Rd). P_{max} indicates the maximal productivity achievable and can be expressed either as gross or nett P_{max}. I_K is a measure of the photosynthetic efficiency at sub-saturating light and is determined by extending a line as a tangent to the initial slope of the curve until it intercepts the P_{max} and dropping a line to the x axis. A small I_K value is indicative of a plant that is making efficient use of available light.

Nett productivity was calculated for every half hour on the basis of the above equation and the irradiance (PAR) data collected at 3 m, 6 m, 12 m and 18 m. Estimates of P_{max}, I_K and Rd were made on the basis of a number of scenarios.

It is worth noting that the literature reveals a range of responses in the photosynthetic parameters of seagrasses. Some authors identify a lack of change in P_{max}, Rd and/or I_K with temperature or depth, whilst others are able to demonstrate changes in these parameters which are dependent on the environment.

This productivity model was utilised under a series of different scenarios in order to demonstrate the effects of a range of photokinetic factors and features of the light-field. The entire model was created and run under a Microsoft Excel 2000 spreadsheet environment.

3.2.1. Scenario 1 – Effect of altering photokinetic parameters (sensitivity analysis)

Good understanding of the outputs of a model relies upon an understanding of the reaction of a model to alterations in the parameters used to formulate it. In this instance, there are four parameters which can be changed – maximal gross photosynthetic rate (P_{max}), subsaturating light intensity (I_K), dark respiration rate (Rd) and the actual light regime itself. In order to facilitate this understanding it is necessary to assess the effect of changes of these parameters in isolation -essentially simplifying the system so that only one variable at a time is having an effect.

In keeping with the philosophy of simplification where possible, rather than using the measured stochastic light field, a more standardised version was provided, by measuring the total amount of irradiance for the year at any given site and then allocating equally to each day. Within each day, hourly irradiance was calculated on the basis of a sine curve:

Light at time H = Sin(Hour of Day) x SiteMultiplier

where hour of day was expressed in radians and SiteMultiplier was a constant (for the site) which ensured total daily light under this model was equal to the average total daily irradiance calculated from the real dataset.

The result is an identical irradiance pattern throughout the day for each day which differed only between sites (and then, only in magnitude as the sine curve pattern was constant between sites).

The standard parameters used were obtained from Masini and Manning (1997) for a population of *Amphibolis antarctica* from Western Australia. These were

Gross maximal productivity (P_{max}) = 0.9375mg C.g $dwt^{-1}.s^{-1}$
Dark respiration (Rd) = 0.2775 mg C.g $dwt^{-1}.s^{-1}$
Subsaturating light level (I_K) = 32 $umol.m^{-2}.s^{-1}$

The model was then run, altering each factor by +/- 20% whilst maintaining the others at a constant level. This is essentially a demonstration of the working of the model rather than a test of any particular hypothesis. It does demonstrate the effects of altering the photokinetic parameters, and acts as a sensitivity analysis.

3.2.2. Scenario 2 - the effect of variable optical water quality

Importantly, each of the sites chosen for this study represents not just a different depth, but also a different distance from shore and therefore from the land-based discharges which originate there. It is therefore important to assess the effect of the differential light penetration (caused by different optical clarity) at varying distances from the shore on the productivity of the seagrasses.

The linear attenuation coefficient (LAC) is a measure of the optical quality of the water. LAC increase is a reflection of greater turbidity, and hence is associated with a smaller fraction of light penetrating to any given depth. This may result in a reduction in productivity. Note that LAC is not dependent on depth, but is an indicator of the quantity of light lost for each metre of water. The potential effect on productivity of such differential turbidity is investigated in this scenario. The hypothesis in this case is that productivity is limited by the lower average daily irradiance *caused by poor optical water quality* (i.e. higher attenuation coefficient). It is important to note that this hypothesis specifically excludes the effect of the naturally lower amount of light which is the effect of deeper water and concentrates on the turbidity of that

water. In this manner, the model tests the effect of increased turbidity by comparing productivity using the measured amount of light with productivity using the amount of light which *would* have been received if the LAC was the same as at the offshore (18 m) site where the influence of turbidity is least.

The method uses a simple productivity model utilising the standardised (sine curve) light field described in Scenario 1 and constant photokinetic parameters across all sites (P_{max}= 1.0275 mg C.g $dwt^{-1}.s^{-1}$, Rd =0.21375 mg C.g $dwt^{-1}.s^{-1}$, I_K= 50.4umol.$m^{-2}.s^{-1}$ from Masini and Manning 1997). Two models are created which

1) reproduce the effect of depth on light field by use of a constant LAC across all sites and

2) use the actual LAC measured across the year for each separate site.

These models are compared in terms of their productivity at each site, thereby demonstrating the loss of productivity associated with poorer water quality close to shore.

Model 1

Average daily PAR was calculated for the 18 m site, and the LAC calculated by reference to the light immediately subsurface. A simulated 18 m light field was created using a sine curve and an appropriate constant to ensure that the modelled light field provided the same total amount of light as that which was actually measured:

Light at time H = Sin(Hour of Day) x SiteMultiplier, where hour of day was expressed in radians

In the first model, the SiteMultiplier was 54.6731 (calculated from measurements at the 18 m site).

This was applied to provide light for 12 hours and the remaining 12 hours were dark. This light field pattern was repeated for 365 days to provide an annual budget with the same total as that measured at 18 m in the field. The 12 m, 6 m and 3 m light fields were then created without reference to any field measurements at these sites. Instead they were provided with a light field which mirrored the 18 m field but multiplied by factors which reflected the different depth of water. i.e. they assumed the same LAC as the 18 m site in each case. This essentially simulates a set of sites with identical optical water quality to that at 18 m, differing only in the amount of light removed because of differing depth. The relative levels of PAR under conditions of constant attenuation coefficient are demonstrated in Figure 8. The appropriate amount of light for any given depth (site) and time was calculated using the formula

$$I_D = (I_{18m} / e^{-K\,18}).e^{-K\,D}$$

Where I_D=Light intensity at a given depth, D and I_{18m} is the intensity at 18 m depth

K is the linear attenuation coefficient (LAC).

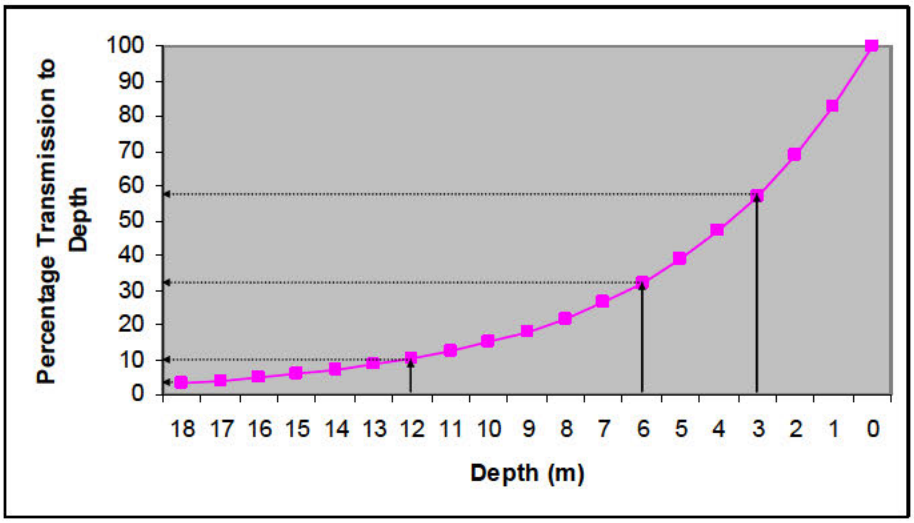


Figure 8: The relationship between depth and percentage transmission of irradiance to the seafloor if constant attenuation coefficient is assumed. Under these conditions it is only the depth of the water which affects transmission. By following the arrows up from the x-axis to the line and then back across to the y-axis, the percentage of subsurface light being transmitted to that depth can be determined. These values provide the ratio of irradiances for Model 1 in Scenario 2.

Model 2

Model 2 differs from Model 1 only in that the attenuation coefficient applied to the standard light environment was that measured from the actual site (calculated on the basis of 12 months of field readings), rather than a single LAC from the 18 m site (as was the case in Model 1). The formulae used were:

Light at time H, depth D m = Sin(Hour of Day) x LAC_D

where: LAC_D is the linear attenuation coefficient for the site representing that depth; LAC_{18m}= 54.6731, LAC_{12m} = 84.7736, LAC_{6m} = 113.1124. LAC_{3m} = 132.7975.

These LAC_D values were calculated based on the relative average daily PAR measured across the course of the year. Note that the LAC_{18m} provides a light environment identical to that of Model 1.

Thus any differences we see between the two models represent only the difference caused by changes in attenuation coefficient (and therefore optical water quality) at different distances from shore.

This is a relatively simple model designed to investigate only the effect of optical water clarity. It focuses on the *difference* between the two models, deliberately simplifying the system to investigate the influence of a single factor, rather than providing a complex model where any differences are difficult to attribute to particular factors. Thus, no attempt is made to put any real credence in the absolute values of productivity as the light field is relatively removed from reality (modelled with consistency across the year). The relativity of the models, however, gives important information on the potential impacts of increased turbidity in the nearshore zone.

3.2.3. Scenario 3 - the effect of light field variability on productivity

The natural light field is a variable one, and it has been suggested that the *variability* may be as important as the average in determining the nett productivity of the seagrasses. For this reason, a comparison of models is made between the standardised light environment outlined in Scenario 1 and two scenarios of reduced light. The first of these situations models a system where the light field has been simply reduced by 20% at all times. The second situation also involves a 20% reduction in the total irradiance, but achieves this through total blackout of the light on one day in every five. Both of these scenarios demonstrate an equal reduction in light quantity (20%), but the first demonstrates no daily variability, whilst the second exhibits a level which has been demonstrated in the field (in extent, if not frequency). Regardless of its applicability it demonstrates the effect of daily variability. Both are compared to the standardised situation.

3.2.4. Scenario 4 – The application of literature photokinetic parameters

Pragmatic considerations prevented an assessment of the photokinetic parameters of the seagrass species. For this reason, values of P_{max}, I_K and Rd were obtained from the literature and applied to the light data which were collected across a twelve month period to represent the Adelaide metropolitan coast. The data used comes from Masini and Manning (1997) and describes the photokinetic parameters of *Posidonia sinuosa* and *Amphibolis antarctica*.

Masini and Manning (1997) present data which describe the photokinetic parameters of *Posidonia sinuosa* at depths of both 4 m and 12-15 m (the deep edge of the bed). As it is available, these differential photokinetic parameters are applied at the different depths. The 4 m parameters are applied to the 3 m population of this study and the 12 – 15 m parameters are applied to the 12 m population from Adelaide. The 6 m site at Adelaide used mean values weighted according to depth (i.e. it was 1/3 of the way between the 3 m and the 12 m data). In the absence of any measurement of photokinetic parameters beyond 12 – 15 m by Masini and Manning, these values were applied also at the 18 m site rather than attempting to extrapolate beyond the depths actually measured. i.e. interpolation between 3 and 12 m was considered acceptable, but extrapolation beyond this was not.

No data on the effect of depth on the photokinetic parameters of *Amphibolis antarctica* were available, so a single set of parameters (from winter) were applied for this species across the year. These data were sourced from Masini and Manning (1997).

The parameters used are described in Table 1. The model is run for both species, first allowing no change of photokinetic parameters with depth, and then again including the change in parameters detailed by Masini and Manning (1997) for *Posidonia sinuosa* in southwest Western Australia. Where no effect of depth was incorporated, the parameters for the 12 m plants were applied to plants at all depths.

As no data was available with which to characterise the manner in which the photokinetic parameters of *Amphibolis* might change with depth, the changes described above for *Posidonia* were converted to percentages, and then applied to the single depth measurements obtained by Masini and Manning (1997) for *Amphibolis*. It was assumed that the reported data referred to shallow (3 m) water plants and parameters were then calculated for the 6 m, 12 m and 18 m sites. As with the *Posidonia*, the parameters remained constant across the 12 to 18 m range as there is no basis for extrapolation.

Table 1: Photokinetic parameters used in the model to simulate productivity under the measured light regime. The data are taken from Masini and Manning (1997) which details the parameters for two depths (4 m and 12-15 m) at a single point in time (winter) for *Posidonia sinuosa* and provides data for *Amphibolis* at a single depth and point in time. Modification of *Amphibolis* values over depth was achieved by mirroring the changes demonstrated by *Posidonia*. Note that both P_{max} and Rd are expressed as per g of canopy, but the Rd value has been doubled to reflect the fact that Masini and Manning express P_{max} per g of leaf biomass, whilst Rd is reported as per g plant weight (i.e. including underground biomass). Thus the value is doubled on the basis that the general relationship in seagrasses is to balance above and below-ground biomass (Duarte and Chiscano 1999).

Species	**Parameter**	**Depth**			
		3 metres	6 metres	12 metres	18 metres
Amphibolis	P_{max} (mg C.gdwt.hr)	0.9375	1.0604	1.3061	1.3061
	I_K (umol photons.m^{-2}.s^{-1})	32.0	29.6	24.8	24.8
	Rd (mg C.gdwt.hr)	.2775	0.2926	0.3228	0.3228
Posidonia	P_{max} (mg C.gdwt.hr)	0.7375	0.8342	1.0275	1.0275
	I_K (umol photons.m^{-2}.s^{-1})	50.4	46.63	39.1	39.1
	Rd (mg C.gdwt.hr)	0.3675	0.3875	0.4275	0.4275

4. Results

4.1. Light Environment

On average, irradiance levels at the water surface followed a truncated sine curve, but levels were substantially depressed in winter compared with summer levels (Figure 9). The daily values used to create this average were, however, highly variable as a result of atmospheric conditions.

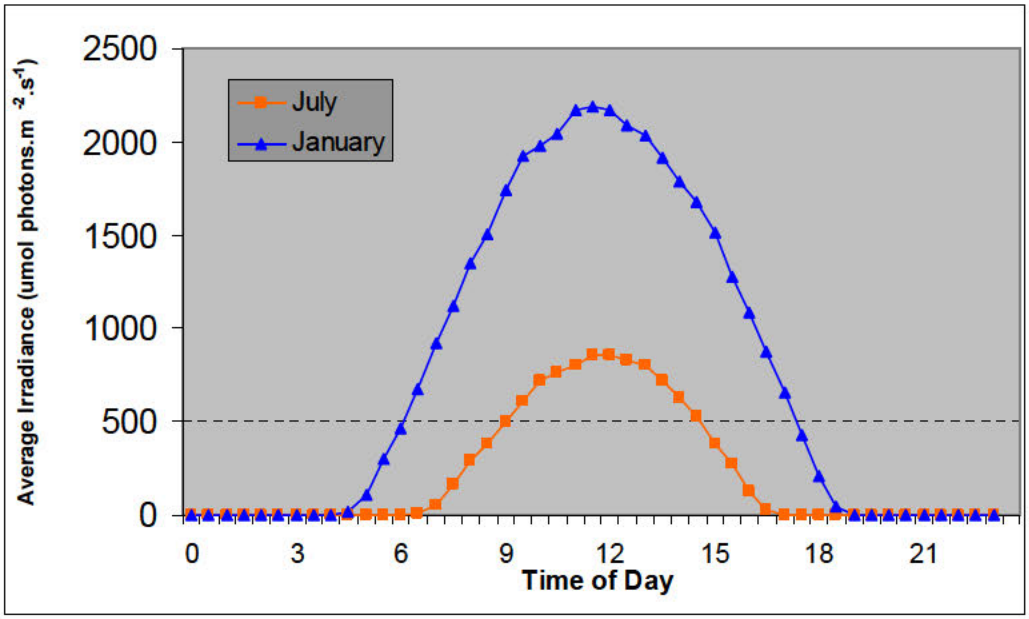


Figure 9: Average irradiance above the water surface in mid-winter (July 2005) and mid-summer (January 2006).

The irradiance reaching the canopy follows a pattern reflected by the depth of the sites (Figure 10). As would be expected, the shallowest site (3 m) experiences the highest total amount of light across the course of the year, followed by the 6 m site, the 12 m site and finally the 18 m site, which was subject to the least irradiance.

Whilst the annual pattern indicates a trend of irradiance decreasing with depth, this was not evident at all times of the year. The 3 and 6 metre sites experienced markedly higher PAR than the deeper sites during the five month period from March to May 2005 and January to March 2006 (Figure 11). However, during the 7 month period, from June until December (inclusive), there was little difference between each of the sites, and indeed, on occasion, slightly higher irradiances were recorded at deeper depths than at the nearshore 3 m site.

It is worthy of note that while canopy level irradiance levels were determined to some degree by the incoming solar irradiance, clearly the turbidity of the water body has an influential modifying influence. It is really only after December that water clarity improves to a point where irradiance at three metres depth reacts to the increasing surface irradiance which has been occurring since June (Figure 11). Indeed, across the period June to December, subsurface irradiance increased from 15.4 to 60.7 mol photons.m^{-2}.day^{-1} (an increase of 385%). Across the same period, PAR at the 3 m site increased from 1.13 mol photons.m^{-2}.day^{-1} to 2.07 mol photons.m^{-2}.day^{-1} (183% increase). Once the water cleared up, in

January, PAR at 3 m increased to 8.3 mol photons.m^{-2}.day^{-1} (a 307% increase) despite no increase in surface light (Figure 11). This is an indication of very poor water quality across the period from June to December. The range, from month to month is far greater at 3 m than experienced at the sites deeper and further offshore.

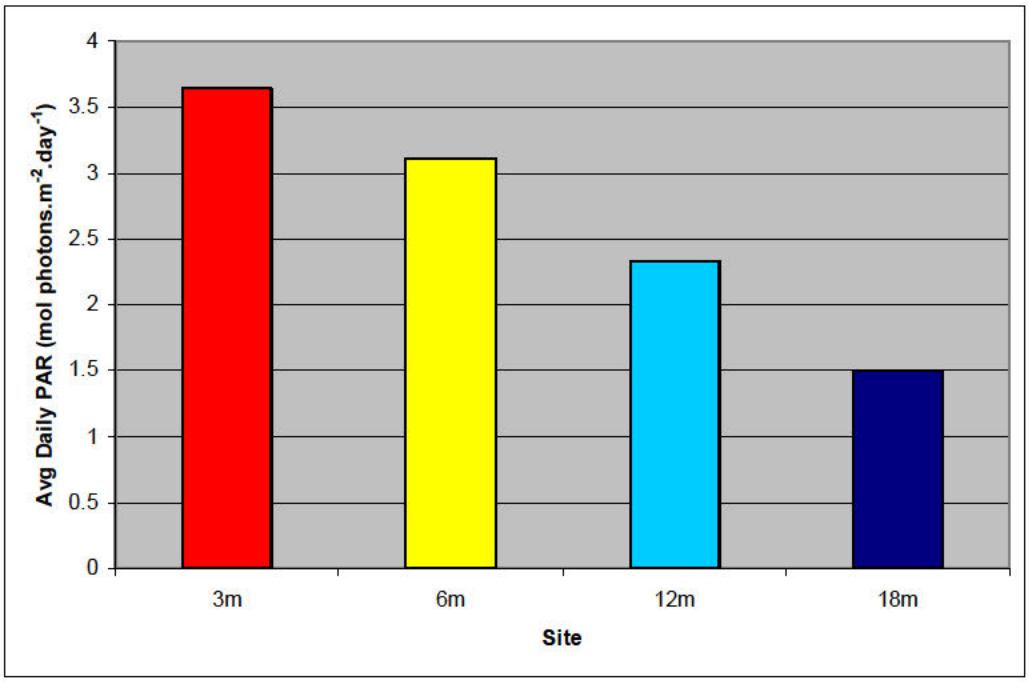


Figure 10: Daily PAR averaged across the annual cycle at 4 depths off Grange. Note that the average daily insolation, calculated across the entire year is greatest at the shallowest depth, and decreases as depth increases. Error bars are not provided as this variability is addressed directly elsewhere (Figures 13 and 14).

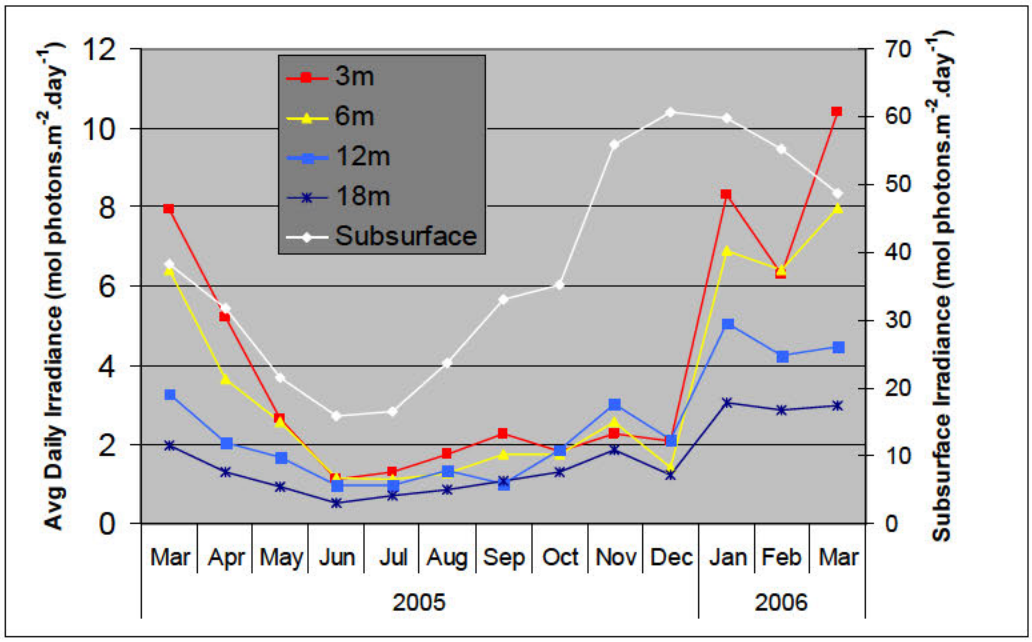


Figure 11: Average daily PAR for each month at each of the sampling locations. Subsurface light is presented on the right hand axis. Whilst the 3 m and 6 m sites were lighter than the

deeper sites in the period January to May, over the period June to December, light in the shallower regions was depressed to a similar level as that found at 18 m.

When the light reaching the canopy at each of the different sites is expressed as a percentage of the surface light, it is clear that it is only in the period January to May that a substantially greater proportion of the surface light is evident at the seafloor of the shallower, more nearshore sites (Figure 12). The proportion of subsurface light reaching the seafloor is far more consistent at the deeper, offshore sites than those close to shore (and the associated land-based inputs). On an annual basis, the 3 and 6 metre sites (9.7% and 8.2% of subsurface light, respectively) demonstrated light environments in excess of the 7.8% required according to DEP (1996) for the survival of *P.sinuosa*. The 12 and 18 metres sites (6.2% and 4% of subsurface light) had light environments well below this level. This was also the general pattern on a seasonal basis; the 3 and 6 metres sites were above the requirement for each season, whilst the 12 and 18 metre sites were below this level.

These findings, in terms of the proportion of subsurface light transmitted to the seafloor, is in keeping with the changes noted in the linear attenuation coefficient (LAC) (Figure 13). LAC is an indication of water clarity, or more specifically, the amount of light which fails to be transmitted across each metre of water. In this way, it is possible to compare optical water quality across a range of sites of different depths. LAC was lowest at the 12 and 18 metre sites and highest at the 3 and 6 m sites. This indicates worse optical water quality at the nearshore sites. In addition to being relatively low, the 12 and 18 metres sites were very similar to one another in terms of LAC. They also varied very little from month to month. In contrast, LAC was extremely high at the nearshore sites, particularly the 3 metre site. It was also extremely variable from month to month.

It is apparent that the water quality is, to a large degree correlated with the amount of outflow from the major land-based discharges – the River Torrens at Henley Beach and the Barcoo Outlet at Glenelg. The six periods of lowest flow are also the six periods of lowest LAC, which indicates the effect of discharge volume on the water clarity of the nearshore regions (Figure 13). However, the relationship is not an entirely simple one, as is indicated by the fact that discharge rates peaked in November, but the attenuation coefficient was greatest in the following month despite a marked decrease in discharge rate in December. It is also necessary to point out that the relationship which is evident between outflow and attenuation coefficient is not a linear one as outflow is expressed on a natural log scale.

In general, there is a relatively rapid response in water quality to events of high flow. Figure 14 demonstrates the relationship between daily flow and light penetration at each of the sites representing different depths. Recovery to higher light levels may take some time after periods of high flow, particularly at the nearshore site, as evidenced by the lack of light present from October 11 to October 15th at the three metre sites despite rising light levels at all the sites further offshore (Figure 14). In contrast, the initial decline is largely synchronous with the flow rates. It is also noteworthy that there is no clear timelag associated with the response of the sites further from shore, at least on a daily timescale.

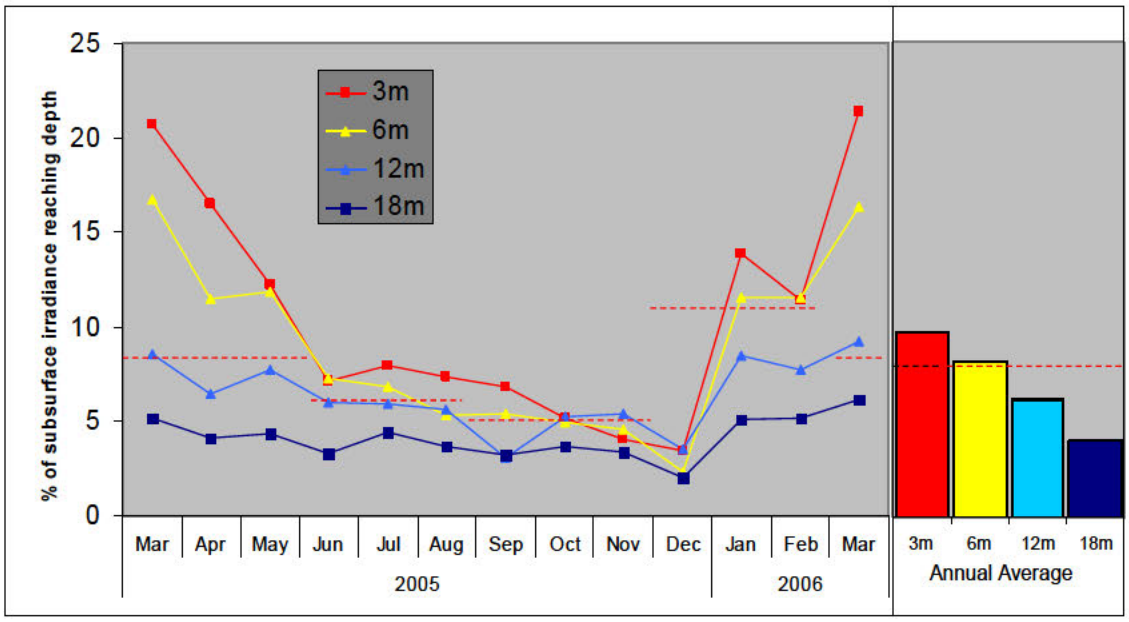


Figure 12: Average percentage of subsurface light reaching the seafloor at the 3, 6, 12 and 18 m sites for each month of the year and as an annual average. This presents the information from Figure 11 in a manner that allows it to be compared with literature values which indicate the percentage of subsurface light required to support seagrass beds. Horizontal dashed red lines indicate the minimum required light levels for *P. sinuosa* in each season and annually according to DEP (1996).

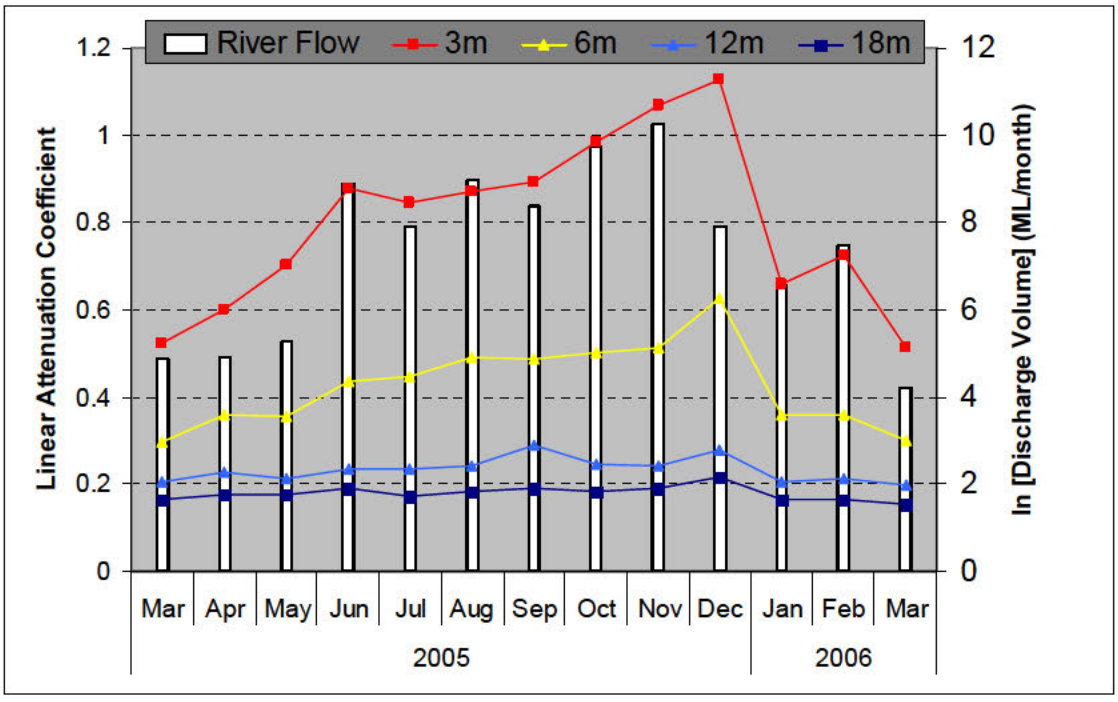


Figure 13: Average linear attenuation coefficients calculated for each month at each site with the combined Barcoo Outlet and Torrens River outflows overlaid. River flow is expressed on a natural log scale. The river flow value for March 2006 is based upon a scaled up estimate of flow from the small dataset available, rather than a full month. The apparent response of attenuation to river flow is most notable in the nearshore (3 m) region and becomes more muted at sites further from the shore.

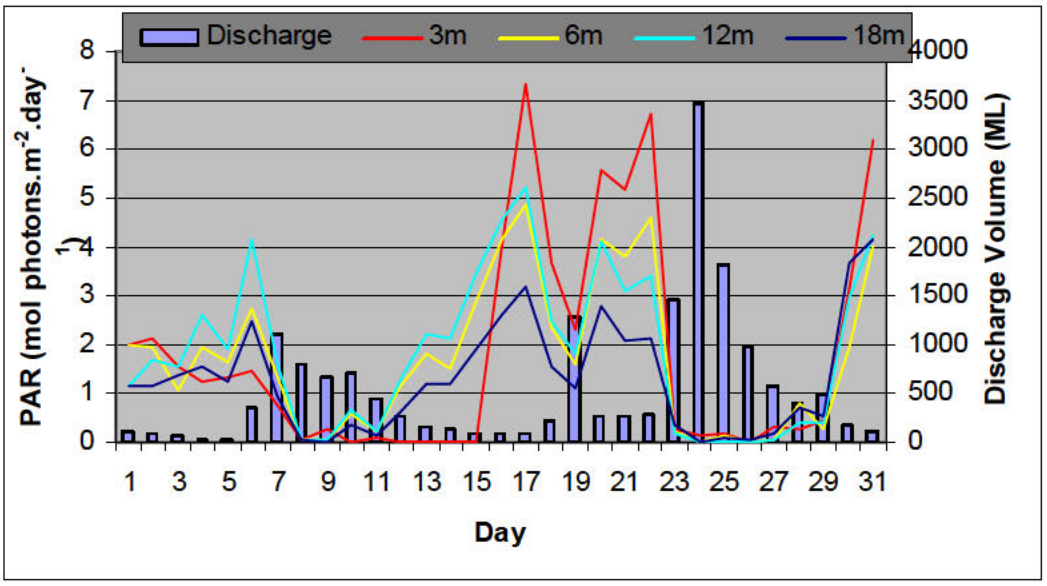


Figure 14: Relationship between discharge volume and irradiance at each site on a daily basis within the month of October. There is a clear effect of periods of high discharge, particularly on the 3 m site. There appears little lag in the onset of this effect, but the period of low light may persist for some time after discharge volumes subside.

Whilst the variability of the light field within each month appears well correlated with the mean light level (Figures 15 and 16), there is a marked increase in variability from June to December which is not as apparent in the mean light levels (Figure 11). In the absence of an effective understanding of the effect of variability of light field on the photokinetic parameters of seagrass, both range and standard deviation are presented (Figures 15 and 16). The general trends are extremely similar. Importantly, the variability is greatest at the shallow, nearshore sites, and least in those sites furthest offshore. It is greatest in summer and least in winter.

In order to identify whether extra variability can be attributed to nearshore sites, it is necessary to negate the influence of the increased mean. The problem is that if water quality remained constant, there would still be apparently greater variability in those sites receiving higher average irradiance. An analysis of the data standardised by the mean of the site and month allows this influence to be removed. It is clear that whilst this extra variability (beyond that of simply higher light levels) is less disparate between sites, it still exists and it is still greater at the nearshore sites than it is further offshore (Figure 17). However, variability is greatest in the winter and spring months, peaking across the period October to December at the 3 and 6 metre sites.

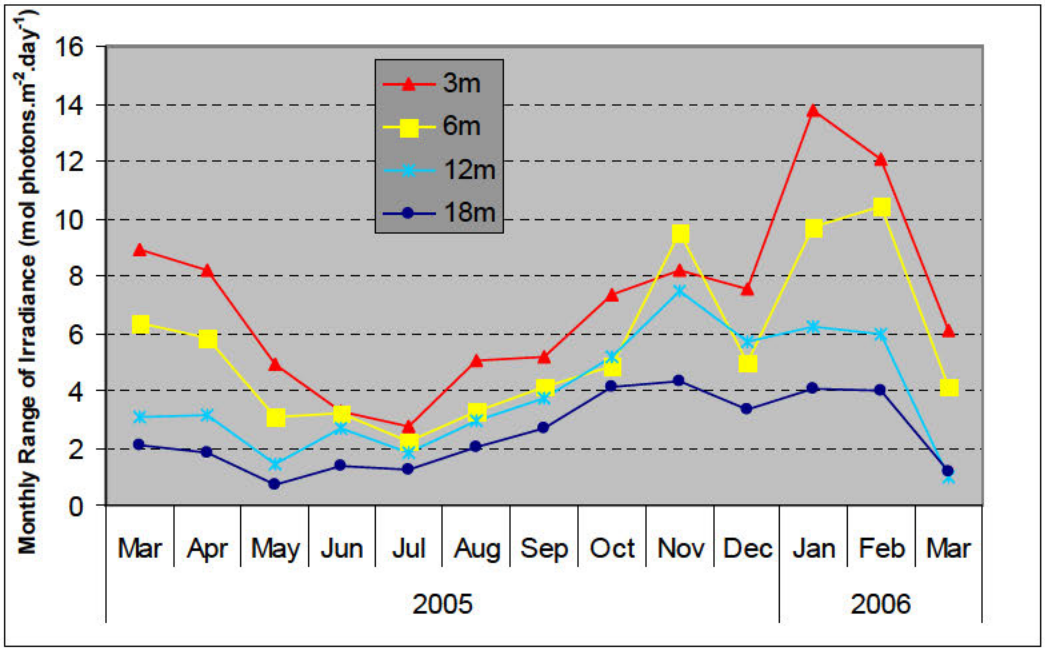


Figure 15: Monthly range of daily PAR totals at each of the different depths. The range of PAR irradiances experienced at each site is greatest in the nearshore region and decreases as distance from the shore increases. This range is greatest in summer and least in winter. Note that the March range in both years is probably artificially low because each of these periods were calculated over considerably fewer days than any other month (20 in 2005 and 11 in 2006). It was not considered appropriate to combine these as they were from periods separated by 12 months.

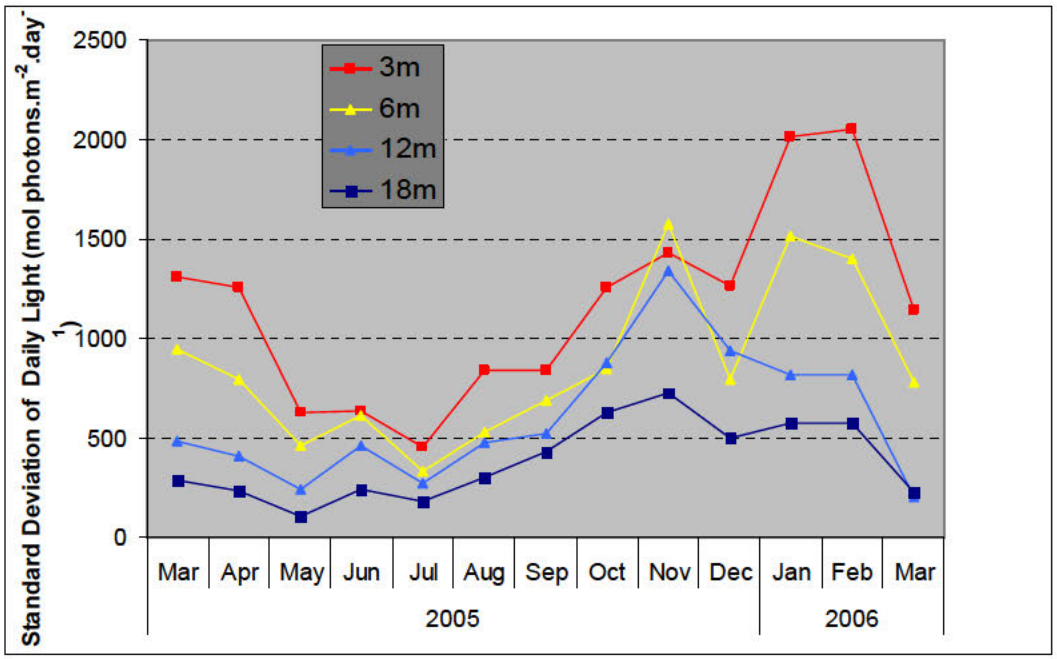


Figure 16: Standard deviation associated with the daily PAR totals within a month at each of the different depths. Standard deviation is greatest in the nearshore region and decreases as distance from the shore increases. It is greatest in summer and least in winter. The March value in both years is probably artificially low for the same reasons as outlined in Figure 15.

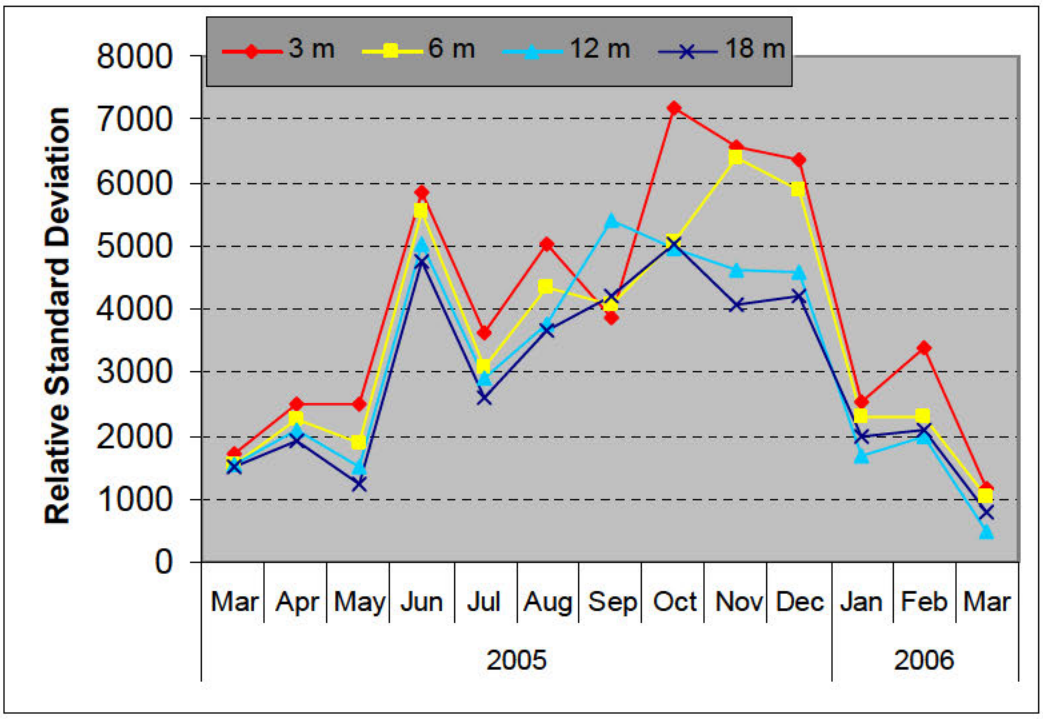


Figure 17: Standard deviation associated with the standardised daily PAR levels. This figure compares the relative variability of PAR after standardization to the mean for month and depth. Whilst removal of the influence of variable mean levels has resulted in greater similarity between depths, there is still a clear trend toward greater variability at the nearshore sites than those further offshore. No units are provided in this instance because the standardization procedure renders the actual figures meaningless except in relative terms to each other.

4.2. Productivity Modelling

4.2.1. Scenario 1 – Effect of altering photokinetic parameters (sensitivity analysis)

By changing one factor at a time, this scenario demonstrates the effect of altering the photosynthetic parameters, P_{max}, I_K and Rd, by a moderate amount (20%). It is designed to provide a gross demonstration of the way the model will react to these changes, and no implication is made that this situation is related to the real-world example.

P_{max} and Rd cause similar additive responses, but they are contrasting in effect. Increasing P_{max} by 20% results in a marked increase in productivity, whilst decreasing it by the same amount has a negative effect of approximately the same magnitude (Figure 18). Rd has a similar effect, but applies in the reverse direction – as Rd *increases* the productivity decreases (Figure 19).

Whilst changing I_K appears to have the same sort of effect as changing Rd (Figure 20 c.f. 19), (i.e. increasing I_K decreases productivity), it does so in an entirely different manner. In the case of Rd, there is a direct *use* of accumulated carbon for metabolic purposes. By contrast, an increase in I_K actually decreases the efficiency of the plant in the accumulation of carbon at lower light levels. Thus, whilst the effects of altering P_{max} and Rd are relatively simple, I_K is more complicated in its effects. This is evidenced by the non-linear nature of the relationship demonstrated in Figure 7.

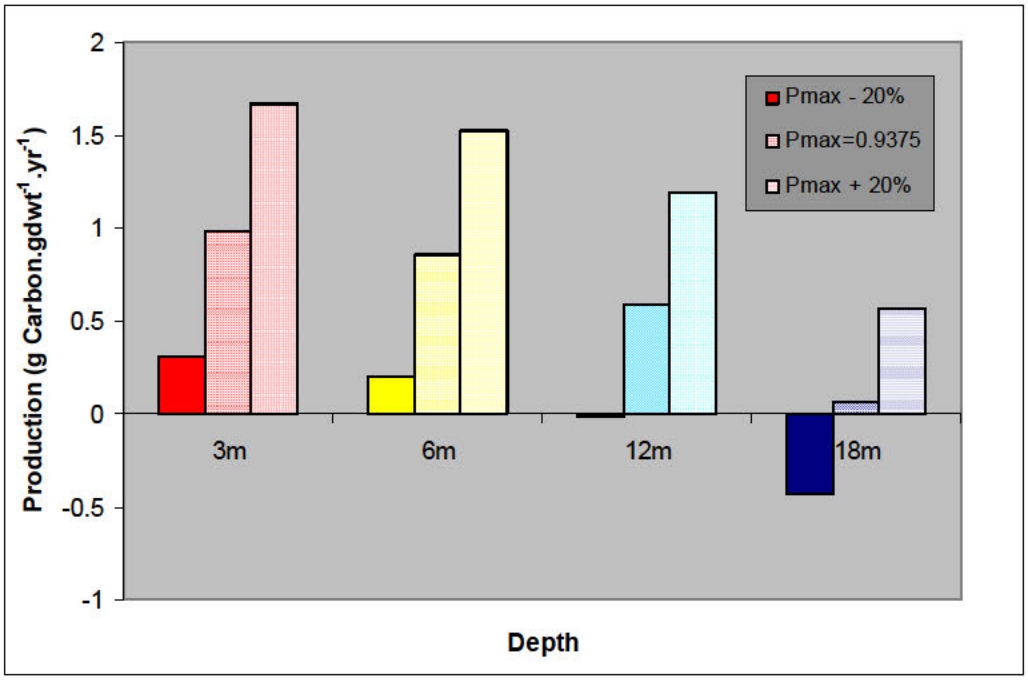


Figure 18: The effect of changing the maximal gross photosynthetic rate. Using the base model described in Scenario 1, and allowing for different attenuation coefficients at different sites (depths), the effect of decreasing (solid bars), and increasing (brickwork bars) P_{max} by 20% is examined. The striped column is the reference and uses a P_{max} of 0.9375 mg C. g $dwt^{-1}.hr^{-1}$. Rd is maintained at 0.2775 mg C. g $dwt^{-1}.hr^{-1}$ amd I_K at 32 $umol.m^{-2}s^{-1}$.

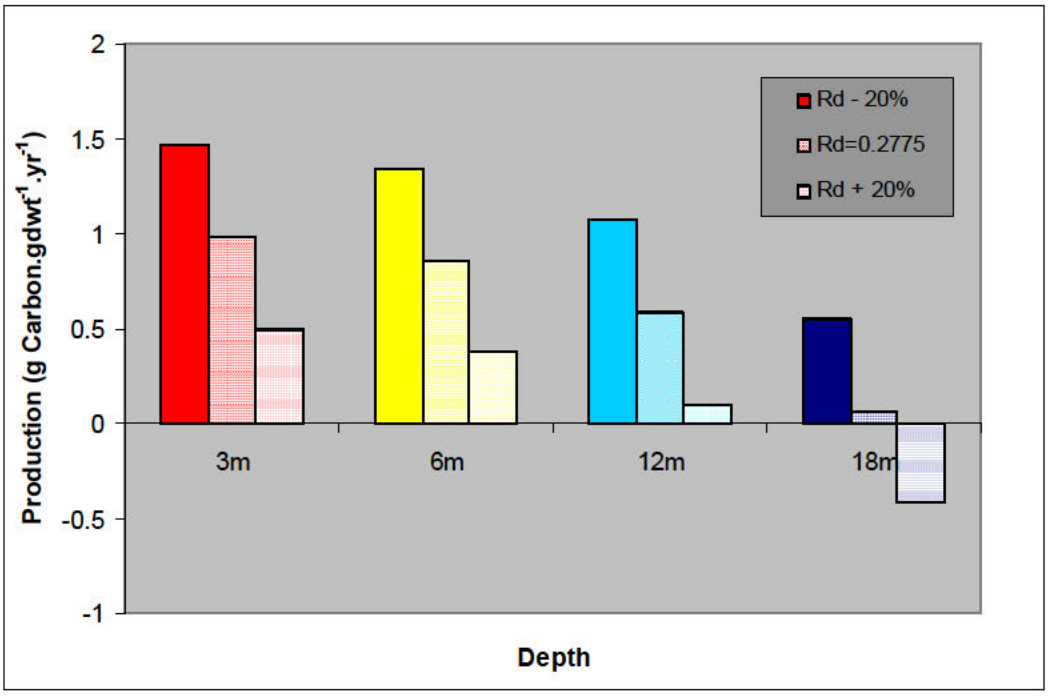


Figure 19: The effect of changing the dark respiration rate. Using the base model described in Scenario 1, and allowing for different attenuation coefficients at different sites (depths), the effect of decreasing (solid bars), and increasing (brickwork bars) Rmax by 20% is examined. The striped column is the reference and uses a P_{max} of 0.9375 mg C. g $dwt^{-1}.hr^{-1}$. Rd is maintained at 0.2775 mg C. g $dwt^{-1}.hr^{-1}$ amd I_K at 32 $umol.m^{-2}s^{-1}$.

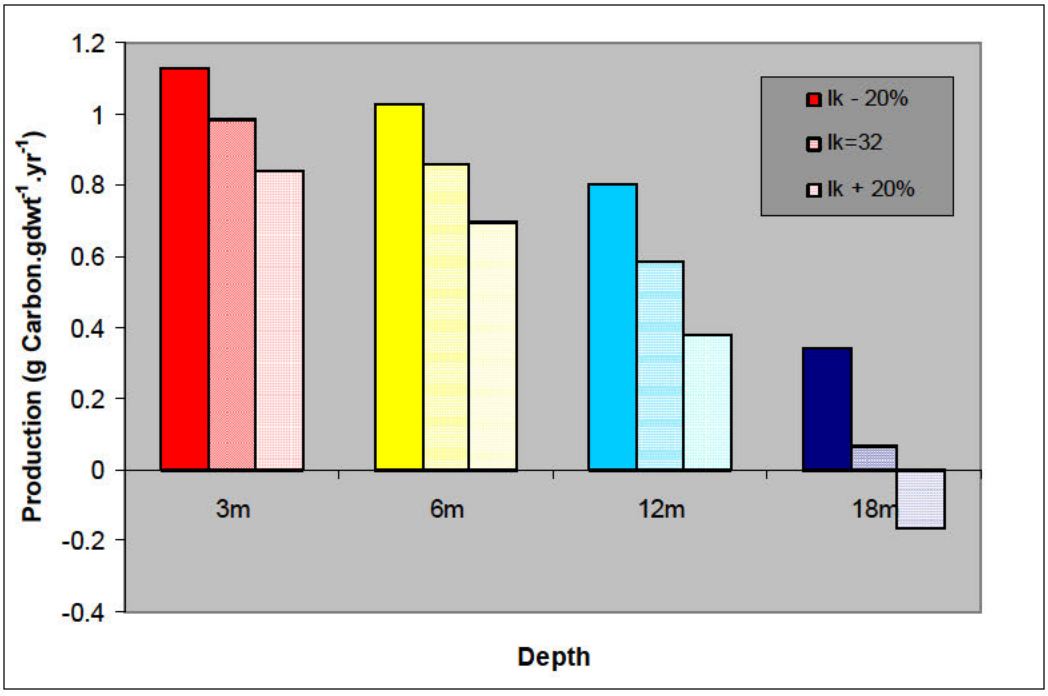


Figure 20: The effect of changing I_K. Using the base model described in Scenario 1, and allowing for different attenuation coefficients at different sites (depths), the effect of decreasing (solid bars), and increasing (brickwork bars) I_K by 20% is examined. The striped column is the reference and uses a P_{max} of 0.9375 mg C. g $dwt^{-1}.hr^{-1}$. Rd is maintained at 0.2775 mg C. g $dwt^{-1}.hr^{-1}$ and I_K at 32 $umol.m^{-2}s^{-1}$.

4.2.2. Scenario 2 - the effect of variable optical water quality

Using this simple model of productivity, it is clear that the more turbid waters close to shore have a marked effect on the amount of light reaching the seagrass (Figure 21). For instance, if the same attenuation coefficient was demonstrated at the 3 m (close inshore) site as was apparent at the 18 m (offshore) site, we would expect to see an average PAR of 22.1 mol $m^{-2}.day^{-1}$. Instead, what we see in reality is only 3.6 mol $m^{-2}.day^{-1}$. The difference between the two models decreases as distance offshore increases (with the consequent improvement in water clarity).

The difference in productivity is not linearly related to the difference in light levels (Figure 21). There is a substantial decrease in productivity caused by the higher attenuation coefficients found closer to shore (for example, productivity at 3 m was 1.49 g $C.gdwt^{-1}.yr^{-1}$ under the constant (18 m) attenuation model, and only 0.98 g $C.gdwt^{-1}.yr^{-1}$ under the model using measured attenuation coefficients. This represents a decrease of 0.51 g $C.gdwt^{-1}.yr^{-1}$. However, even at 12 m, where the difference in light regime between the models was not nearly as marked, the lost productivity still amounted to 0.52 g $C.gdwt^{-1}.yr^{-1}$. Thus, even moderate decreases in water quality can have a marked effect on productivity.

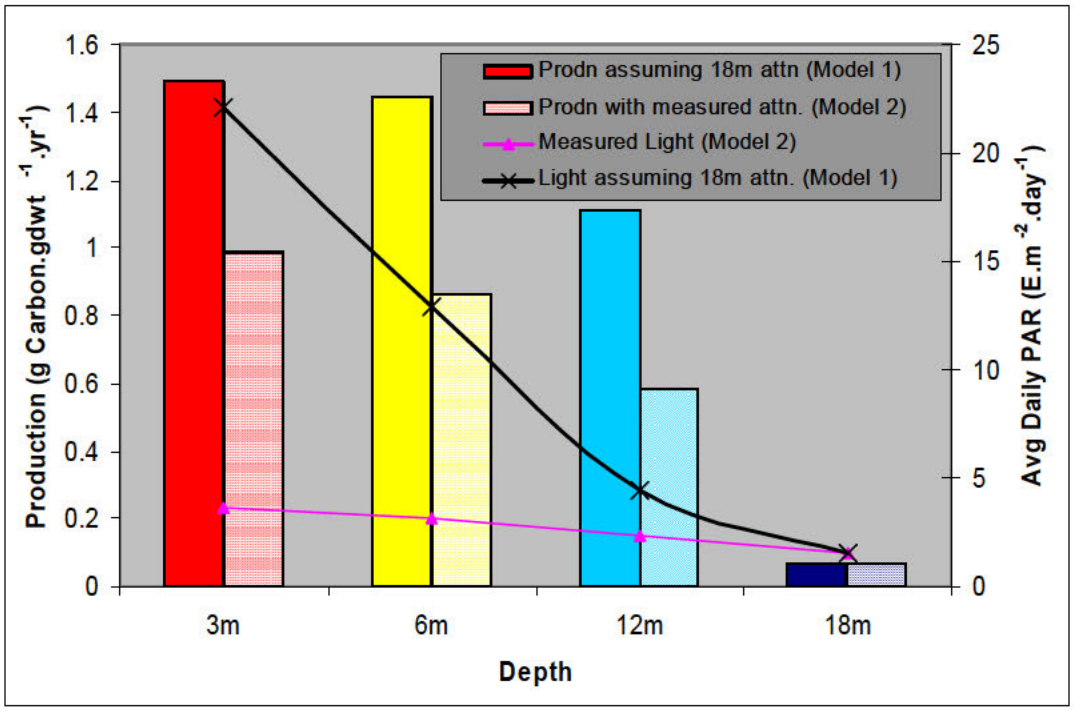


Figure 21: The effect of variable attenuation coefficient on light and productivity. A simple model (see details in methods) to demonstrate the effects of a spatially variable attenuation coefficient on productivity and light.

1. Solid bars represent productivity on the basis of the light at 18 m being extrapolated to other depths under the assumption that the linear attenuation coefficient was the same at all sites as 18 m (Model 1). The black line represents the average daily PAR under this scenario.
2. Striped bars show the productivity when the actual attenuation coefficient from each site was used (Model 2). The pink line represents the average daily PAR under this scenario.

The difference between the scenarios represents the effects of variable attenuation coefficient.

4.2.3. Scenario 3 - the effect of daily light field variability on productivity

This scenario investigated the effects of variability in light climate on productivity. Comparison was made between the productivity achieved under the standard light environment, that achieved under a 20% reduction in total irradiance by a simple multiplication of each light value by 80%, and that where the same reduction was achieved by simulating the original situation with every fifth day being completely dark.
It is clear that reducing the light climate causes a substantial reduction in productivity, and equally, that reducing it by simulating light fluctuations across days caused a greater loss than by simulating a simple shading by 20% effect (Figure 22). In both cases, the 18 m site was unable to achieve compensation (nett productivity ≤ 0), but this was particularly the case where fluctuations were introduced.

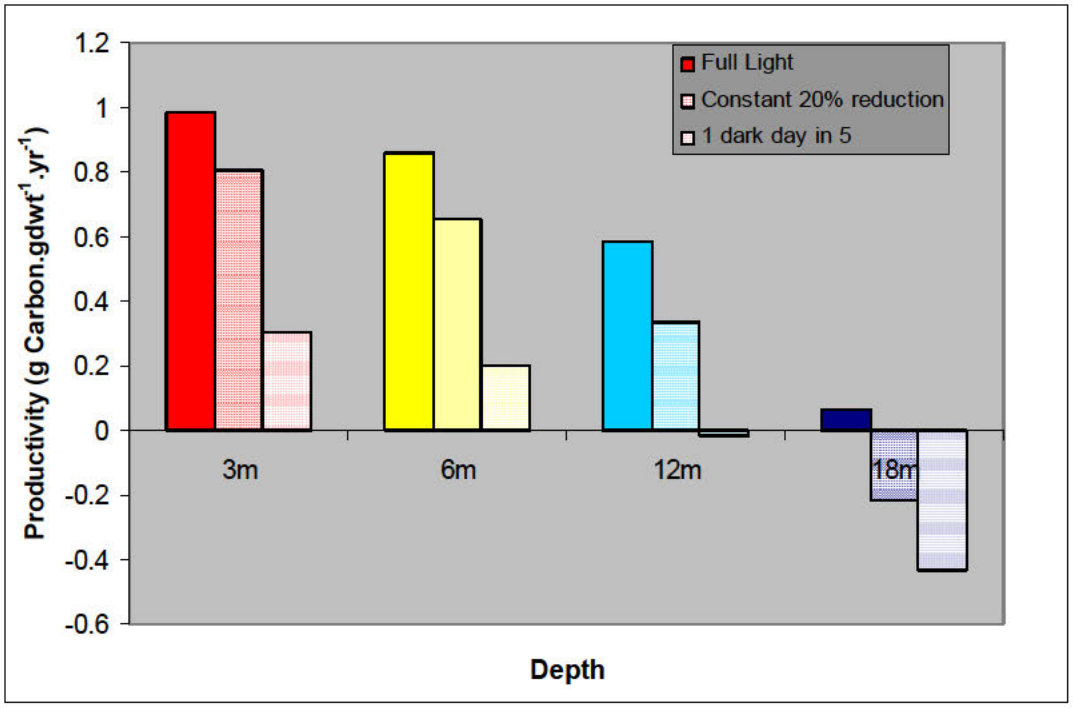


Figure 22: The effects of altering light levels on productivity. Solid columns represent the productivity under the standardised light field described in Scenario 1. Striped columns represent production under a light regime where the incoming light has simply been decreased by 20%. Brickwork columns also represent a decrease of 20% of the recorded total light dose, but it is achieved by alternating between full (standard) light days and (on every fifth day) zero light days. Whilst diminishing the light in a uniform manner does decrease productivity, it is far more detrimental to decrease the light in a fluctuating manner.

4.2.4. Scenario 4 - The application of literature photokinetic parameters

4.2.4.1. No photoacclimation included in model

Using the data supplied for *Amphibolis antarctica* by Masini and Manning (1997), and assuming no photoacclimation with depth (i.e. all photokinetic parameters remain the same across the depth profile), it is evident that productivity in the natural (fluctuating) light field is far lower than that modelled under conditions of a standardised light field, despite the fact that the average daily light dose remained the same (Figure 23). It is also noteworthy that the model indicates that productivity under the measured light conditions is similar at all sites except the 18 m site which is lower. Whilst we would expect the 18 m site to be lower as it is on the deeper edge of the seagrass bed, the three metre site (where seagrasses have been lost) demonstrates no less productivity than the 6 and 12 metre sites which do support seagrass. Thus this model, parameterised as it is, does not provide evidence that light conditions at three metres cause diminished productivity, possibly leading to loss of *A. antarctica*.

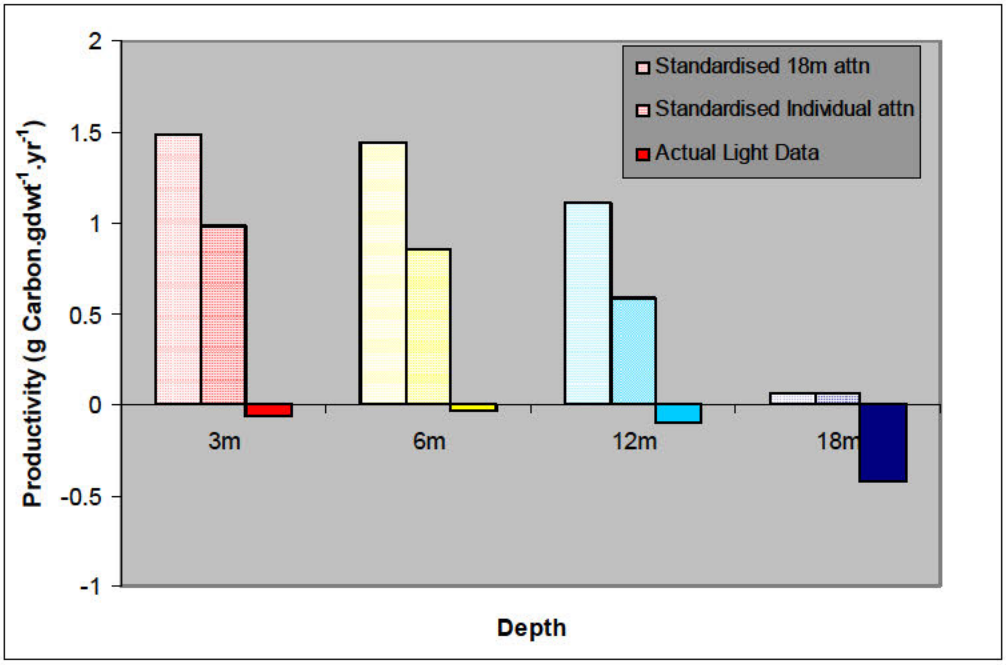


Figure 23: Annual productivity of *Amphibolis antarctica*. Constant I_K, P_{max} and Rd values are maintained across both time and depth. P_{max} of 0.9375 mg C.g $dwt^{-1}.hr^{-1}$, an Rd of 0.2775 mg C.g.$dwt^{-1}.hr^{-1}$ and an I_K value of 32 $\mu mol.m^{-2}.s^{-1}$ PAR were assumed, using the data of Masini & Manning 1997 for *A. antarctica* in southern Western Australia. The model is run with the standardised light field assuming 18 m attenuation, with the standardised field using measured attenuation (both of which are consistent between days across the year), and with the actual light data.

The situation for *Posidonia sinuosa*, again using data from Masini and Manning (1997) also fails to provide a scenario which explains seagrass loss in the inshore regions when photokinetic parameters are kept constant across the depth profile (Figure 24). Like *Amphibolis*, *Posidonia* demonstrates far less productivity under the measured, naturally fluctuating light fields than where the light field is standardised. It also demonstrates a situation where nett annual productivity is approximately the same at all sites except 18 m which is lower. Thus the scenario does not demonstrate a situation whereby poorer optical water quality causes productivity at the three metre site to be lower than at deeper sites

further offshore. Furthermore, the fact that all sites demonstrate nett negative productivity is not consistent with the fact that seagrass does exist at the 6, 12 and 18 metre sites.

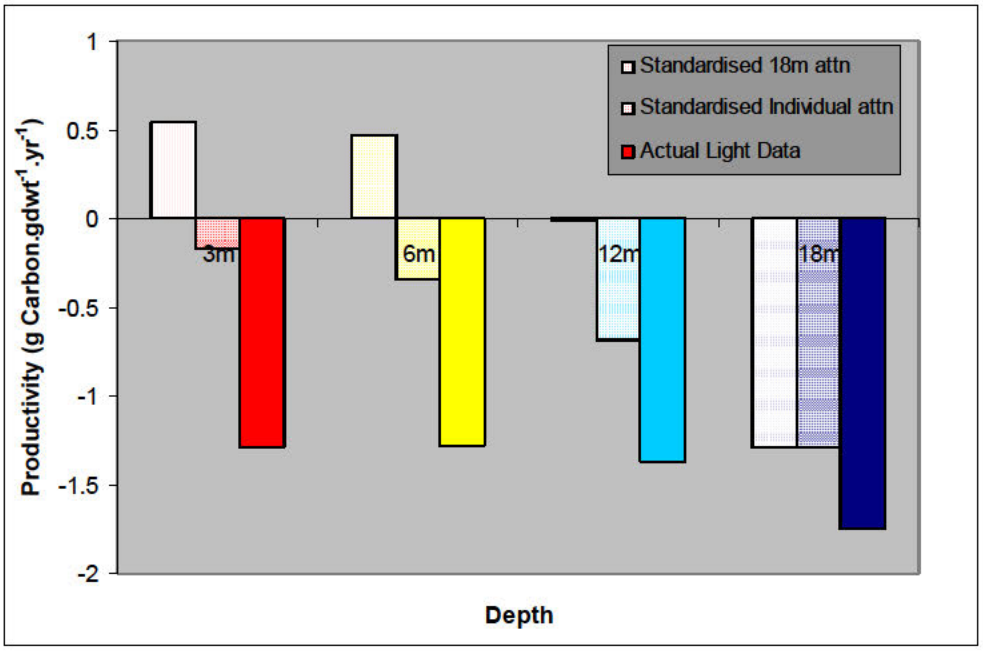


Figure 24: Annual productivity of *Posidonia sinuosa*. Constant I_K, P_{max} and Rd values are maintained across both time and depth. P_{max} of 1.02 mg C.g $dwt^{-1}.hr^{-1}$,Rd of 0.214 mg C.g.$dwt^{-1}.hr^{-1}$ and I_K of 39.1umol$m^{-2}.s^{-1}$ were assumed, simulating values typical of 12 m *Posidonia sinuosa* plants (Masini & Manning 1997). The model uses the standardised light field assuming 18 m attenuation, the standardised field using measured attenuation, and the actual light data. Under this scenario, the 3 metres site did not demonstrate lower productivity than the other sites, regardless of which light field was used.

4.2.4.2. Photoacclimation included in model

Masini and Manning (1997) provide data which describes the photokinetic parameters for *Posidonia sinuosa* plants at both 4, and 12 to 15 metres depth. This allowed a scenario to be developed where changes in photokinetic parameters could be integrated within the model. The model was run using the 4 m parameters to describe the seagrass at the three metre site, and the 12 to 15 metre parameters were applied to our 12 metre site. Our 18 metre site also used the same parameters without any attempt at extrapolation, whilst the 6 metre site used a depth weighted average of the literature values for three metres and those for 12 metres.

Using the depth dependent photokinetic parameters of Masini and Manning (1997) the model demonstrates higher productivity at the three metre site than the 18 metre site when using the normalised light fields with both site-specific and constant 18 m attenuation coefficient (Figure 25). However, when the depth dependent parameters are applied in conjunction with the actual fluctuating light levels, the model indicates a situation where productivity is greatest at 12 metres, but least at the three and 18 metre sites. This description could be somewhat misleading – whilst accurate, in considering relative productivity, it is necessary to remember that under no circumstances was nett productivity ever positive. This indicates a situation where seagrasses would never be able to produce enough to balance respiration and therefore never survive. As seagrass does exist at three of the four sites, this is obviously unrealistic.

If changes in photokinetic parameters with depth are simulated for *Amphibolis*, it is clear that productivity is markedly lower under conditions of natural, fluctuating light than it is when standardised light fields are used. Furthermore, when the real light data are used, *Amphibolis antarctica* demonstrates a far lower productivity at the 3 metre site than at any other depth (Figure 26). In fact at 3 metres, it demonstrates a nett carbon loss across this annual cycle. Next lowest productivity was demonstrated by the 6 and18 metre sites, which demonstrated marginally positive nett productivity. It is worthy of note that at the three metre site, under conditions of depth-related photokinetic parameters, *Amphibolis* could demonstrate nett negative productivity. However, this only occurred when the actual measured light climate was utilised. Under the more benign standardised light fields, positive nett productivity was achieved, although it was still less productive than the 18 metre site when the site-specific LAC values are used to model productivity. Thus, this represents the application of a reasonable set of photokinetic parameters to the actual light data, resulting in a scenario which sees the three metre site unable to support seagrass, whilst the sites further offshore are more productive.

An assessment of productivity on a monthly basis for each of these sites reveals that the period from June till December (inclusive) is particularly poor in terms of productivity for both *Posidonia* and *Amphibolis* (Figure 27). It is worthy of note that the period from October to December is characterised, for both species, by a substantial increase in productivity at the 12 and 18 metre sites which is not demonstrated by those sites closer to shore. The fact that *Posidonia* displays positive nett productivity in only a single month and for only one site is a further indication that the data provided by Masini and Manning (1997) are not applicable in this situation.

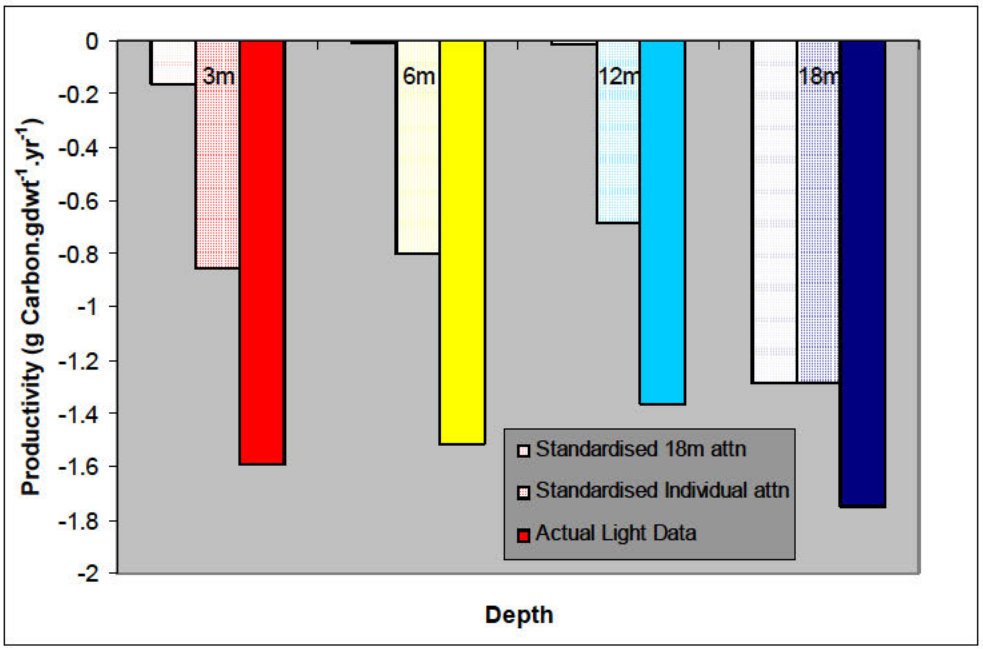


Figure 25: Annual *Posidonia* productivity assuming maintenance of constant I_K, P_{max} and Rd values across time but allowing for changes across the depth profile. Details are provided in Table 1. The model is run with the standardised light field assuming 18 m attenuation (brickwork), with the standardised field using measured attenuation (striped), and with the actual light data (solid bars). The three metre site is less productive than either the 6 or the 12 m sites, under all three light scenarios, but is less productive than the 18 m site.

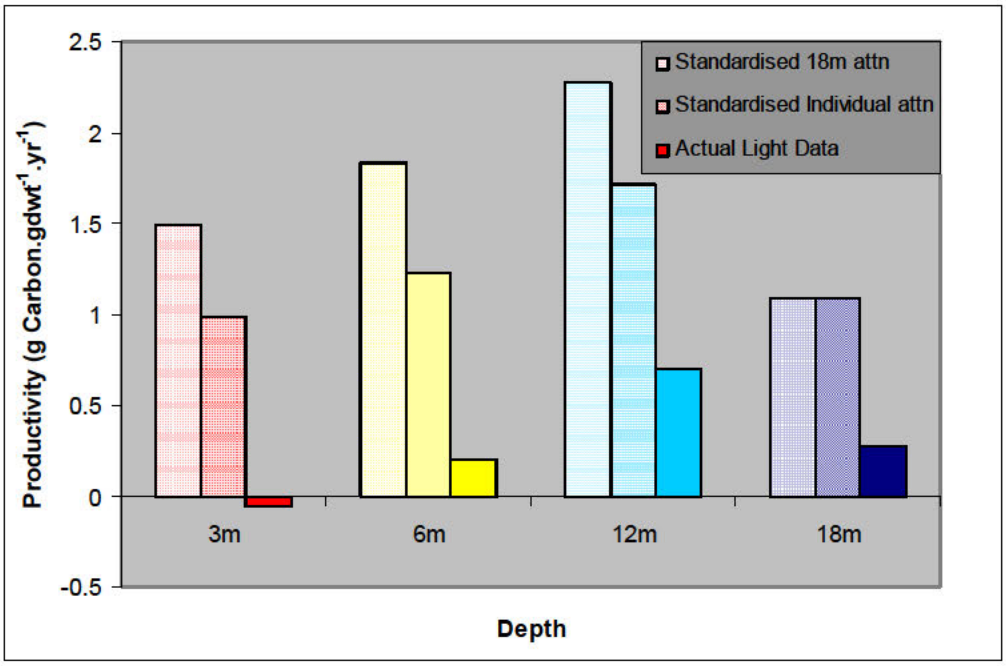


Figure 26: Annual *Amphibolis* productivity assuming maintenance of constant I_K, P_{max} and Rd values across time but allowing for changes across the depth profile. Details are provided in Table 1. The model is run the standardised light field assuming 18 m attenuation (brickwork), with the standardised field using measured attenuation (striped), and with the actual light data (solid bars). The three metre site is less productive than either the 6 or the 12 m sites, under all conditions, and is worse than the 18 m site under all light scenarios except for that which assumed constant LAC across sites.

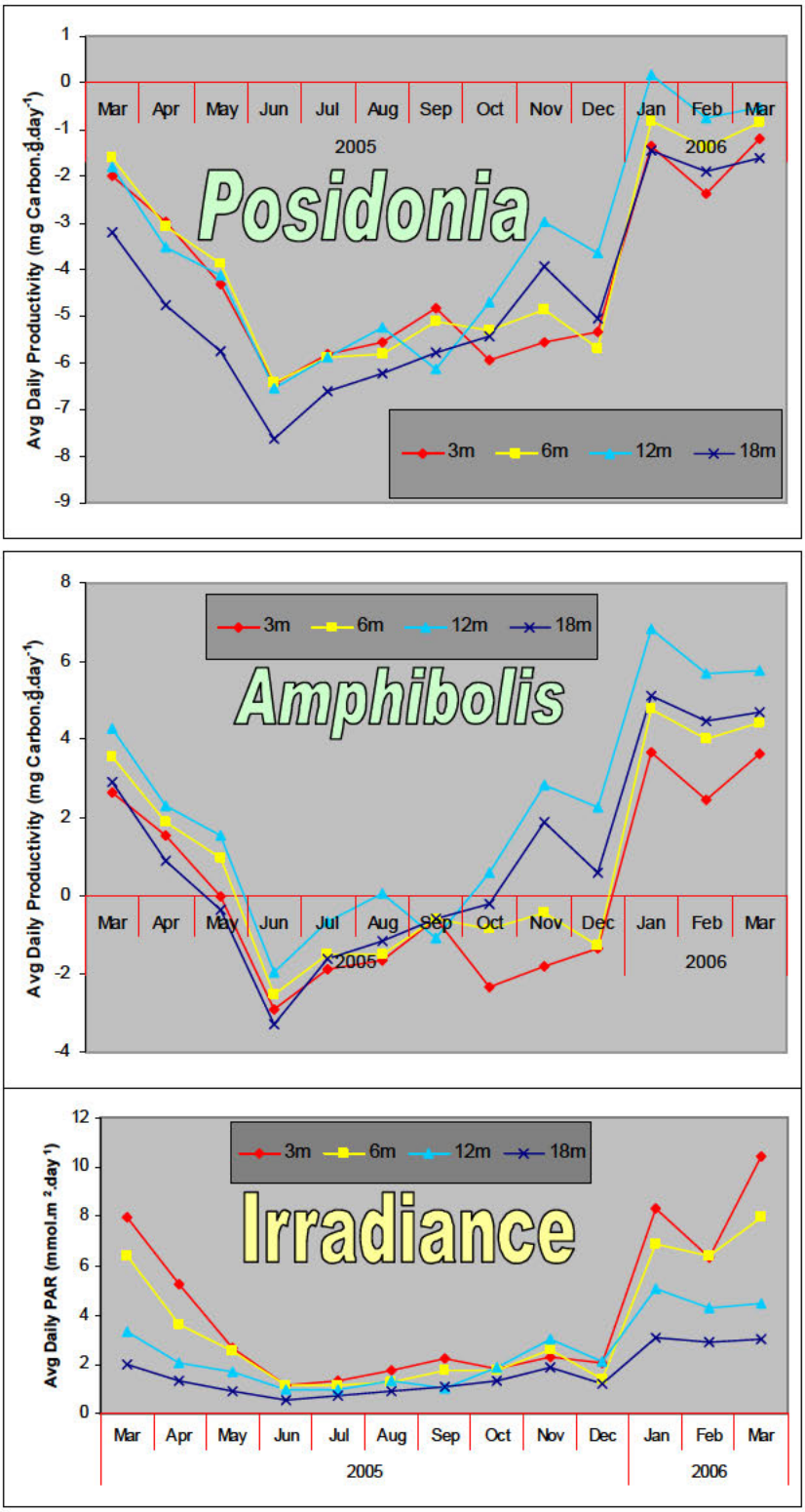


Figure 27: Monthly production across the course of the study for both *Posidonia* and *Amphibolis*, assuming the photosynthetic parameters typical of *Posidonia sinuosa*, and allowing variability with depth. *Amphibolis* photokinetic parameters were, on a proportional basis, varied in the same manner across depth. The irradiance data upon which the output is based are presented in the lower portion of the figure.

5. Discussion

The loss of seagrass from the nearshore region of the Adelaide Metropolitan Coast is unusual as the common pattern is a retreat *toward* the shore from the deeper offshore (e.g. Duarte 1991). The deep margin is generally believed to be defined by the point where there is insufficient light to produce enough photosynthesis to balance respiratory and other demands (Duarte 1991; Fourqurean and Zieman 1991). Thus, increasingly bad water clarity will reduce light at this already critical point and the seagrass will no longer have enough light to support itself at this depth (Duarte 1991). As a result, the offshore margin retreats toward shallower waters where more light is available. This study investigated whether the proximity of land-based inputs of turbidity (stormwater drains, creeks and rivers) and poor mixing characteristics might produce a light environment less favourable in the nearshore area despite the fact that the water column is so much shallower. If this is true, then a case could be mounted that the loss of seagrass from the nearshore region may have been due to poor productivity caused by poor water clarity.

The initial argument investigated the simple question of whether the total amount of light (integrated across an annual period) was less at the three metre nearshore site than it was at sites further offshore which were able to support seagrass beds. It was demonstrated that the total annual light budget at the three metre site was greater than at all other sites (Figure 10), invalidating the hypothesis that the total light budget could have been responsible for the decline of seagrass in this region. It is worth noting, however, that despite achieving a higher total irradiance than sites further offshore, this is due in large part to being so shallow. If the same clarity existed at the 3 m site as the 18 metre site then the three metre site would receive 614% more irradiance than it actually does under its own, more turbid, water column. Thus, whilst we cannot demonstrate a scenario whereby seagrass may have been lost from the nearshore zone because of the absolute amount of irradiance reaching the seafloor, it cannot be denied that the nearshore region of this segment of the Adelaide metropolitan coastline does have poor water clarity.

The linear attenuation coefficient (LAC), which describes water clarity, varies considerably across the course of the year in a way which is relatively consistent, both on short and medium term timescales, with the volume of land-based turbid inputs (Figure 13). Importantly, the three metre site has, by far, the worst water clarity, demonstrating LACs of between 0.51 m^{-1} and 1.13 m^{-1} as an average for a month. In comparison, at the 18 m site, LAC was relatively low and consistent, varying between 0.15 m^{-1} and 0.22 m^{-1}. These attenuation coefficients are similar to those recorded over a far shorter time period by Phillips and Scholz (1982). They recorded levels off the Adelaide coast of 0.4 m^{-1} to 0.5 m^{-1}. However, these readings were taken on relatively calm days. A longer term study, integrating stormier periods, is likely to have produced higher values. Elsewhere, Ruiz and Romero (2001) in a study of the effects of light attenuation utilised a “highly disturbed” site with a LAC of 0.205 m^{-1}. Duarte (1991) presents a comparison of seagrass depth limits with recorded attenuation coefficients. Of 72 recorded attenuation coefficients, only 8 exceeded that recorded in our study at 3 metres (0.82 m^{-1}). Of these eight, only one (in Western Port Bay; Bulthuis 1983) had seagrass beds which extended below a depth of 2.5 m. Thus, the Adelaide population of seagrasses would have to be very unusual to be able to survive at a depth of 3 metres with an attenuation coefficient as low as measured in this study.

The high light attenuation coefficients result in a substantial proportion of the subsurface light being cut out before it reaches the seagrass canopy, where it could otherwise drive productivity. Attenuation of light reduces the incoming light to differing degrees according to time of year. This difference is particularly marked at the nearshore sites. Over the annual cycle, 9.7% of light reaches the canopy at 3 metres, 8.3% at 6 m, 6.1% at 12 m and 4.0% at 18 m. These figures are remarkably low in comparison to findings elsewhere. Duarte (1991)

reports a reasonably consistent average of 11% of surface irradiance must be achieved to support most seagrass species. Similarly, Masini et al. (1995b) found that *Posidonia sinuosa* required 10% of surface irradiance at the level of the canopy, and DEP reported an annual requirement for 7.8% of subsurface light. On this basis, it appears that the seagrasses of the Adelaide metropolitan coast are surviving at considerably lower levels (4%) than have generally been reported.

The annual light budget measured here for a range of depths off the Adelaide coast is an important set of data when considering the impact of light levels on seagrass beds. Comparisons with literature values are useful and indicate a high degree of photosynthetic efficiency, but the significance would be further strengthened by comparable studies in South Australian regions other than the Adelaide metropolitan coast.

There are no historical data to describe water clarity in a manner comparable to the current study. However, the relatively clear relationship between turbidity and land-based inputs allows some insight into conditions in the past. Many authors (e.g. Orth and Moore 1983; Longstaff and Dennison 1999; Ruiz and Romero 2003) have commented on the significant effect of runoff on the turbidity of the receiving body of water. Prior to the 1930s, the Torrens River entered the Port River via a series of wetlands, which would have had the capacity to considerably reduce discharge and silt loading to the sea. However, in 1932, Breakout Creek was constructed which diverted the Torrens River directly to the sea in Holdfast Bay, causing a significant increase in the input of turbid water to the nearshore coastal system. This was reduced with the construction of the Kangaroo Creek reservoir on the River Torrens in 1969 (Wilkinson 2005). Thus it is the period from 1932-1969 which probably represents the worst time for water clarity and consequently seagrass productivity. Present conditions are therefore probably worse than the period prior to 1932 but still more productive than the years between 1932-1969. The added mobilisation of sediment associated with the loss of stabilising seagrass beds remains unquantified, but may be responsible for poorer conditions in more recent times.

Whilst the annual budget is greater at the 3 metre site, this situation is not constant throughout the year. Across the period June to December, there is very little difference in light budget between all sites, a feature correlated with the volume of land-based discharges. The three metre site fails to demonstrate the significantly higher light levels which might otherwise be expected. This has been commented upon previously by Phillips and Scholz (1982) in their surveys of the attenuation coefficients of the waters of Gulf St Vincent. They were surprised that the attenuation coefficient failed to improve in November and December beyond that of June, when runoff was far higher. This similarity across two studies 30 years apart may be an indicator of a biological phenomenon such as phytoplankton blooms occurring consistently in this spring/summer period. As this is a period where it might be expected that non-photosynthetic reserves would be being laid down to buffer against times of low productivity in winter, this timing is of concern. Masini et al. (1990) identify this as a critical period for *Posidonia sinuosa* for this reason. However, it should be noted that the three metre site does not (at least on a monthly basis) experience less light than the 18 metre site, where the light is clearly sufficient to provide for enough productivity to support at least some seagrass.

This extrapolation assumes no adjustment of photokinetic parameters with depth (acclimation effects), a scenario often reported in the literature whereby plants in constant low light conditions optimise their photosynthetic performance for that range of light (Mazzella and Alberte 1986; Perez and Romero 1992; Masini and Manning 1997; Major and Dunton 2002; Campbell et al. 2003). If plants at the 3 metre site have different photokinetic parameters to those elsewhere, then this simple comparison of light levels may not be appropriate, as the relationship between light and productivity becomes variable.

While the subject is a controversial one and the results conflicting, it has been suggested that plants tend to acclimate to the ambient light conditions (Falkowsi and Raven 1997; Raven 1994). This essentially is a protection and/ or optimisation response. Highly efficient photosystems may be damaged, when suddenly exposed to a high light environment. Therefore, plants are able to "detune" their photosynthetic apparatus in response to a period of high light (i.e. good optical water quality). However, the response to low light (i.e. increased efficiency at low light levels) is often a slow one, as demonstrated for *Posidonia sinuosa* by Masini and Manning (1997) or may even fail to occur (e.g. Major and Dunton 2000). For this reason, acclimation to high light conditions would be a distinct disadvantage when it is followed by a period of low light intensity. Thus, the *variability* of the light field may be as important as the mean value. In this case, it is clear that the variability is greatest at the three metre site, from where seagrass has been lost. Depending on how the photosystems are acclimated, this may put these plants at a significant disadvantage.

The combination of the shallow depths allowing the possibility of a high degree of light penetration and the drastic reductions caused by the nearshore-entrained periodic turbidity events leads to a far greater monthly range of light conditions in the shallow regions than deeper ones. That this greater variability is due not only to higher potential light conditions, but also a greater influence of turbidity events in shallow waters, is evidenced by the fact that when the daily light doses are standardised by the average daily input for the month at each site, the nearshore sites still demonstrate higher variability. Thus the influence of the entrainment of periodic nearshore turbidity events does increase the variability of the light field, thereby producing conditions less favourable for the seagrass. Interestingly, this is particularly the case across the period September to December, which was identified as a critical growth phase by Masini et al. (1990) when productivity should be strongly positive to produce storage carbohydrate for use in less productive times. However, this period is characterised by a light regime which is both of low intensity and highly variable, and particularly so at the nearshore (three metre) site. Thus, the light regime is likely to represent a significant stressor to seagrass beds in this region.

The light climate is not of itself what directly determines the survival of a seagrass bed. Rather, it is the productivity of the bed which is the direct cause, and light climate is *one* of the factors which affects productivity (Masini et al. 1995a; Touchette and Burkholder 2000). The other important factor to consider here is the relationship between light climate and productivity – a particularly efficient plant may be productive despite low light levels, whilst an inefficient individual may require far higher light levels to be sufficiently productive to survive. Thus, demonstrating a poor light climate, as has been done thus far, does not necessarily implicate low productivity as the cause of seagrass loss. This argument can be strengthened significantly by a productivity model which utilises measured, or at least reasonable, photokinetic parameters and applies these to the measured light field to make predictions regarding the level of productivity. Essentially, this assists in putting some perspective on the measured light climate, and assists in determining whether it is likely to be responsible for productivity levels which might be so low as to result in loss of seagrass beds.

Measurement of the photokinetic parameters of the seagrasses, both across the depth profile and across the annual cycle, would have allowed a far more detailed examination of this question. This would have allowed an incorporation of innate biological rhythms and the seasonal effects of temperature (Pérez and Romero 1992; Masini et al. 1995a; Herzka and Dunton 1997; Alcoverro et al. 2001). However, it was not pragmatic within this project. Therefore, the object of the modelling was to demonstrate, using reasonable parameters defined by literature values, that a scenario could be illustrated which explained seagrass loss.

In simple experimental terms, the hypothesis was that the light climate of the Adelaide metropolitan coast in the nearshore (3 m) region is insufficient to allow enough productivity to support seagrass with depth dependent photokinetic parameters measured for the same species in Western Australia. Support for the hypothesis would consist of a situation which demonstrated productivity estimates in the order 3 m < 18 m < (6 m or 12 m). 3 m must be lowest because it is only here that seagrass is absent. The 18 m site must be next lowest as this represents the point at which the seagrass bed peters out on the deep margin, a point generally assumed to be defined by productivity levels being unable to balance respiratory and other demands. Thus productivity here must be higher than the 3 m site, but not as high as the 6 m and 12 m sites. As the 6 m site is only just within nearshore edge of the seagrass bed, it might be reasonably assumed that this site should demonstrate lower nett productivity than the 12 m site or even the 18 m site (both the 6 m and 18 m sites are very close to the margins of the bed).

Seagrasses represent a more complicated system to model than many other organisms (Bearlin et al. 1999). In part this is because of the complex interactions of storage carbohydrates and the differential physiological behaviour of the above and below-ground components (Fourqurean and Zieman 1991; Alcoverro et al. 2001). A critical concept here is the fact that the below-ground components (roots and rhizomes) act as storage organs (Masini and van Senden 1995; Touchette and Burkholder 2000; Cabello-Pasini et al. 2002; Fourqurean et al. 2003). This highlights the necessity to use a model which is run on a long enough time scale. It should incorporate periods where productivity debt is balanced by material in below-ground biomass stored during periods of high productivity. It also highlights the need to assess productivity on a basis which includes the respiratory demands of the below-ground biomass (see also Herzka and Dunton 1998; Alcoverro et al. 2001). Our model and light data represent such a long term view.

In addition to investigating support for the hypothesis that the light climate might, through its influence on productivity, be responsible for seagrass loss, this model allowed some general statements to be made regarding aspects of the light climate which may increase or decrease productivity.

With steep decline in seagrass beds around the world (e.g. Brush and Nixon 2002), many authors have attributed loss, at least in part, to poor water clarity (e.g. Peres 1984 in Shepherd et al. 1989; Longstaff and Dennison 1999; Ruiz and Romero 2001, 2003; Zimmerman 2006). An important finding from this study was that, regardless of whether it caused actual seagrass loss, there was a substantial reduction in productivity caused by the increased turbidity entrained within the nearshore region. Using standardised (i.e. sine curve simulated identically for each day) light fields which used light intensity assuming a constant attenuation coefficient (i.e. the turbidity at all sites was constant and equal to that of the 18 m site) productivity was far greater than it was when the actual individual attenuation coefficients were applied to the data. This is an indication of the fact that the poor optical water quality has a substantial deleterious effect on amount of photosynthetically active radiation reaching the canopy and the nett productivity of the seagrass.

Furthermore, any reduction in productivity caused by lower average light levels is magnified when day to day fluctuations are included in the model. Figure 22 illustrates that a decrease in productivity, caused by a reduction in light, is made worse when that reduction is achieved by greatly reducing light on a single day rather than reducing it by a smaller amount on every day. This demonstrates the multiplicative problems in the light climate facing the Adelaide metropolitan coast, where land-based inputs becoming entrained in the nearshore zone have reduced light, and done so in a way which fluctuates greatly from day to day.

Major sources of the sediment causing this turbidity are probably storm water inputs, the River Torrens and the Barcoo outlet. Whilst not representing the total land-based

discharges, they are likely to be strongly associated with storm activity, and therefore other inputs such as stormwater drains are likely to be well correlated. However, quantifying the relative magnitude of these has not been investigated as part of this study. It is worth noting that dredging will also add to the sediment load, but is more a process of resuspension than an input to the system. Furthermore, given the repetitiveness of the operation, it will reduce light in a more consistent manner than the massive sporadic turbid inputs which occur during periods of high rainfall, and consequently high river flow. This is not to negate the effect of dredging on light levels, merely to indicate that the effect will tend to be felt in terms of average level of irradiance rather than variability of those levels.

Beyond being able to demonstrate that the low, fluctuating light conditions of Adelaide's nearshore margin are detrimental to the productivity of seagrass beds, parameterising the model with photokinetic parameters has demonstrated that the light conditions may be responsible for loss of seagrass from the shallow waters. However, such a demonstration requires the incorporation of photokinetic parameters which vary with depth, and even then, it is possible to demonstrate scenarios which are either consistent or inconsistent with the hypothesis of productivity-mediated seagrass decline, depending on the specific set of parameters used.

In the absence of a set of photokinetic parameters measured on a seasonal basis and across a range of depths on the Adelaide metropolitan coast, it was necessary to rely on data accumulated from Western Australia (Masini and Manning 1997) and apply this to the light data collected from Grange. Clearly the use of photokinetic parameters from populations outside of the Adelaide region is not ideal. This needs to be kept in mind in considering the confidence with which we can state that seagrass decline in the nearshore region is due to poor light conditions. Because of these limitations, the object of the model was simply to demonstrate whether it was possible to eliminate poor light conditions as the cause of the seagrass decline.

The characterisation of photokinetic parameters provided by Masini and Manning (1997) was utilised because it describes the situation for *Posidonia sinuosa* and *Amphibolis antarctica*, which represent two of the major groups of seagrasses on the Adelaide metropolitan coast. Whilst data exists elsewhere for other species, this was considered most relevant because differences between species are likely to be large. However, application of the parameters from this single paper is likely to represent a relatively crude simplification for a number of reasons. In particular, depth specific data for *Posidonia sinuosa* is collected only in winter, and therefore takes no account of any seasonal or temperature related changes. Furthermore, Masini and Manning (1997) make no attempt to identify depth related changes in the photokinetic parameters of *Amphibolis antarctica*. Whilst this paper, and others do provide information on the effects of temperature on productivity, it was not considered appropriate to structure the model with such effects as they could not be verified for the Adelaide populations, so the additional complexity would produce no further confidence in the conclusions. In the absence of data from Masini and Manning (1997) on the effects of depth on photokinetic parameters of *Amphibolis antarctica*, an assumption has been made that the proportional change is the same as that of *Posidonia*. This is not an unreasonable assumption, but it does remain untested.

Whilst it would have been possible to produce scenarios based on a wide variety of photokinetic parameters, this was not necessary to address the hypothesis which was posed. In the absence of a set of depth related photokinetic characters from the Adelaide coast, there was only a requirement to demonstrate that productivity-mediated seagrass loss was possible. Application of data beyond the set used (which was considered the most appropriate as it dealt with the both *Posidonia sinusosa* and *Amphibolis antarctica* and included changes in depth for *Posidonia*) would simply result in a collection of results, some of which supported the hypothesis and some which did not. The conclusions would be unaltered – it is possible to demonstrate scenarios which are consistent with the hypothesis,

but it is also possible to demonstrate those which do not. Thus we could not rule out the possibility of productivity-mediated loss. Rather than complicate the issue, a single set of data was used to provide this demonstration.

When the attenuation coefficient data obtained in this study is put into the context of the depth limits of other species found elsewhere, it is clear that the seagrasses of the Adelaide metropolitan coast are surviving to a depth which is extremely unusual given the measured light conditions. Duarte (1991) provides a regression which relates the LAC of the water column to the depth limit of the seagrass bed. On the basis of this regression, it is suggested that seagrass could extend to 2.2 m, 4.4 m, 8.5 m and 11.3 m according to the LACs measured at our 3 m, 6 m, 12 m and 18 m sites. i.e. that seagrass should not be found at any of our sites based on the clarity of the water. Given that this is clearly not the case at the 6, 12 and 18 m sites, it is evident that the seagrasses of the Adelaide metropolitan coast are unusually efficient at utilising available light.

Both of the taxa involved in our study, and the two which have been implicated in seagrass loss from the Adelaide coast are morphologically large species. Larger species tend to have higher light requirements because of the large amount of non-photosynthetic biomass involved in respiration (Ruiz and Romero 2001). For this reason they tend to be more sensitive to chronic light reduction (note though that short term light reductions are likely to be better tolerated because of the large stored source of carbohydrate represented by the below-ground biomass). Whilst this general hypothesis is consistent with the finding that these species have disappeared from the metropolitan coast, it is at odds with the apparent efficiency of these populations and their ability to grow deeper than the LAC would suggest.

Modelled annual productivity rates for *Posidonia sinuosa* are clearly an undersestimate as nett productivity is uniformly negative when depth adaptation is assumed, and there is therefore little point in making comparison to literature values. *Amphibolis*, however did demonstrate a reasonable scenario so it is worth comparing productivity here with that found in the literature. At best (i.e at the 12 m site), annual nett production was only 0.7 g C g dwt of leaf^{-1} yr^{-1}. If this is scaled to represent a square metre (assuming 500 g dwt m^{-2} leaf weight), it represents 350 g C m^{-2} year^{-1}. Cambridge and Hocking (1997) report productivity in the range of 500-1000g dwt m^{-2} yr^{-1}for *Posidonia sinuosa* but this represents total productivity rather than just carbon, so it would adjust downwards toward 168-336 g C m^{-2} yr^{-1} assuming 33.6% carbon by dryweight (Duarte 1990). Duarte and Chiscano (1999), in a reassessment of the productivity of seagrasses in general, estimate productivity of seagrass communities (on average) at 1012 g dwt m^{-2} yr^{-1}, which represents approximately 340 g carbon dwt m^{-2}yr^{-1}. Thus modelled productivity for *Amphibolis* in this study appears relatively high. However, it is worth noting that Perez and Romero (1992) in a study of *Cymodocea nodosa* in Spain found their model overestimated productivity by approximately 60% compared with the actual field values, presumably because of factors such as self-shading. Our modelled figures for *Amphibolis* also do not take into account such factors, and therefore are probably also an overestimate. However it can be said that they are in the expected range for seagrasses.

The fact that using the parameters of Masini and Manning (1997) results in apparent negative nett productivity for *Posidonia* in the present study indicates that either the light recorded over this annual cycle is atypical of previous years (and less productive) or, as is more likely, that the parameters measured in the Western Australian populations are not applicable to the seagrasses beds growing off Adelaide. Photoacclimation to the light environment presented by the Adelaide coast is an unknown. Furthermore, in light of the ability of Adelaide seagrasses to survive in light levels which Duarte (1991) indicates are below the level required by most species, it must be acknowledged that these parameters underestimate productivity. This does not imply that the levels of productivity relative to each

other are incorrect, but our conclusions must reflect this uncertainty. Nevertheless it does highlight the urgent need for such photophysiology studies to be carried out on seagrass beds of the Adelaide region.

This study has demonstrated that the nearshore region of the Adelaide metropolitan coast has water clarity characteristics which are detrimental to seagrass species. Highly variable and low light levels are strongly associated with land-based turbid inputs. Productivity modelling has provided a demonstration that these characteristics cause low productivity and may have been responsible for the loss of seagrass beds from this area. Whilst photokinetic studies are required to draw this conclusion with greater confidence, this study has failed to rule out the possibility, and has demonstrated that, at the very least, these conditions represent a serious stressor for seagrass beds in the region. It has also highlighted the need to concentrate research on this dynamic region, where seagrass beds may be continuing to recede seawards, remaining stable, or beginning to revegetate after documented historical losses. Optical water clarity, through its effect on productivity, is likely to be an extremely important variable to consider.

6. Conclusions and further directions

This study began by specifying five specific hypotheses which we aimed to test. We are now in a position to address each of these:

1. That there was less photosynthetically active radiation at the nearshore site than further offshore. Using an extensive dataset which spanned the entire annual cycle, it was demonstrated conclusively that this hypothesis was false. In terms of the average daily dose of PAR, there was greater light at the nearshore site than at sites further offshore. Whilst the optical clarity of the water was significantly worse in the region where seagrass had been lost, the effect of the shorter water column outweighed this, resulting in greater light at the three metre site than any other.

2. That the light climate was more variable at the nearshore site than further offshore. Despite the fact that variability can be described in various ways (e.g. range, standard deviation, standard deviation as a function of mean), all measures indicated a greater variability in the three metre site than at the others.

3. That reduced light levels are caused by increased land-based runoff.
Whilst this was not an hypothesis which could be tested by experimentation, there was a clear correlation between discharge volumes of the main land based sources (which we treated as a surrogate for the total land-based discharges) and the optical clarity of the water. This relationship was evident across a medium timescale (i.e. comparison of months) and on a daily timescale. There was no consistent lag evident on a daily scale, indicating rapid mixing of the turbid water to quite some distance from shore. However, the effect was far more muted at sites further offshore, indicating some degree of entrainment and/or relatively rapid settlement of suspended particles from the water column.

4. That variability in light climate (without any change in mean levels) is disadvantageous for seagrasses on the basis of lower productivity.
Using our model with a variety of modeled light datasets, it was established that a constant daily light field resulted in greater productivity than a light field which represented the same total amount of light but was delivered in a more variable fashion (ie one dark day in five). Thus, in the absence of any difference in mean light levels, variability in light climate represents a stressor for the plants.

5. That the light climate of the Adelaide metropolitan coast produces conditions which, in the context of reasonable photokinetic parameters, explain the loss of seagrass from the nearshore zone of this region.
There was variable support for this hypothesis, depending on the set of photokinetic parameters utilized. Unless depth dependent changes in photokinetic parameters were utilized, it was not possible to demonstrate, for either *Posidonia* or *Amphibolis*, a scenario consistent with the productivity-induced loss from the nearshore site whilst seagrass beds were maintained further offshore. When depth dependent changes in photokinetic parameters were included, it was possible to demonstrate a scenario whereby seagrass may have been lost because of poor productivity levels. However, confidence in the extrapolation of results from Western Australia is not high because it would indicate that *Posidonia sinuosa* makes a nett productivity loss on an annual cycle at all sites, and therefore should not occur at any depth, which it quite clearly does. Thus, whilst it is possible to demonstrate a situation for *Amphibolis* which shows seagrass loss on the basis of poor productivity, the conclusion must be that the model fails to rule out the possibility, but further work is required to provide strong support. What can be said, however, is that nearshore Adelaide coastal waters represent a poor environment in terms of optical quality, and that these conditions, whilst they may not be solely responsible for seagrass loss in the area, represent a significant stressor, which may, in conjunction with another factor, be responsible for such a loss.

This work has yielded an excellent record of the light climate of the Adelaide coast in the Grange region. In order to strengthen arguments for the effect of this light environment on the loss of seagrass beds, further work should be directed towards identifying the photosynthetic characteristics (P_{max}, Rd and I_k) of *Posidonia* and *Amphibolis* off the coast of Adelaide. The application of such parameters from Western Australia has proven a useful exercise, but to take this model further requires a knowledge of the characteristics of local populations, both across the course of a year and as they vary across a depth / light profile.

7. References

Alcoverro T., Manzanera M. and Romero J. 2001. Annual metabolic carbon balance of the seagrass *Posidonia oceanica*: the importance of carbohydrate reserves. *Marine Ecology Progress Series* 211: 105-116.

Bearlin A.R., Burgman M.A. and Reagan H.M. 1999. A stochastic model for seagrass (*Zostera Muelleri*) in Port Phillip Bay, Victoria, Australia. *Ecological Modelling* 118: 131-148.

Best E.P.H., Buzzelli C.P., Bartell S.M., Wetzel R.L., Boyd W.A., Doyle R.D. and Campbell K.R. 2001. Modeling submersed macrophyte growth in relation to underwater light climate: modelling approaches and application potential. *Hydrobiologia* 444: 43-70.

Brush M.J. and Nixon S.W. 2002. Direct measurements of light attenuation by epiphytes on eelgrass *Zostera marina*. *Marine Ecology Progress Series* 238: 73-79.

Bulthuis D.A. 1983. Effects of *in-situ* light reduction on density and growth of the seagrass *Heterozostera tasmanica* (Martens ex Aschers.) den Hartog in Western Port, Victoria, Australia. *Journal of Experimental Marine Biology and Ecology* 67: 91-103.

Burke M.K., Dennison W.C. and Moore K.A. 1996. Non-structural carbohydrate reserves of eelgrass *Zostera marina*. *Marine Ecology Progress Series* 137: 195-201.

Burt J.S., Masini R.J. and Simpson C.J. 1995. Light and *Posidonia sinuosa* seagrass meadows in the temperate coastal waters of Western Australia. I. Factors influencing water column light attenuation. Department of Environmental Protection, Perth, Western Australia. Technical Series 61.

Cabello-Pasini A., Lara-Turrent C. and Zimmerman R.C. 2002. Effects of storms on photosynthesis, carbohydrate content and survival of eelgrass populations from a coastal lagoon and the adjacent open ocean. *Aquatic Botany* 74: 149-164.

Cambridge M.L. and Hocking P.J. 1997. Annual primary production and nutrient dynamics of the seagrasses *Posidonia sinuosa* and *Posidonia Australia* in south-western Australia. *Aquatic Botany* 59: 277-295.

Campbell S., Miller C., Steven A. and Stephens A. 2003. Photosynthetic responses of two temperate seagrasses across a water quality gradient using chlorophyll fluorescence. *Journal of Experimental Marine Biology and Ecology* 291: 57-78.

Chalker B.E. 1981. Simulating light-saturation curves for photosynthesis and calcification by reef-building corals. *Marine Biology* 63: 135-141.

Cheshire A.C., Butler A.J., Westphalen G, Rowland B., Stevenson J. and Wilkinson C.R. 1995. Preliminary study of the distribution and photophysiology of the temperate phototrophic sponge *Cymbastela* sp. from South Australia. *Marine and Freshwater Research* 46: 1211-1216.

Cheshire A.C., Wilkinson C.R., Seddon S. and Westphalen G. 1997. Bathymetric and seasonal changes in photosynthesis and respiration of the phototrophic sponge *Phyllospongia lamellosa* in comparison with respiration by the heterotrophic sponge *Ianthella basta* on Davis Reef, Great Barrier Reef. *Marine and Freshwater Research* 48: 589-599.

Clarke S.M. 1987. Sediment-seagrass dynamics in Holdfast Bay: Summary. *Safish* 11: 4-10.

Cummings M.E. and Zimmerman R.C. 2003. Light harvesting and the package effect in the seagrasses *Thalassia testudinum* Banks ex König and *Zostera marina* L.: optical constraints on photoacclimation. *Aquatic Botany* 75: 261-274.

DEP (1996) Southern Metropolitan Coastal Waters Study (1991-1994) Final Report.

Duarte C.M. 1990. Seagrass nutrient content. *Marine Ecology Progress Series* 6: 201-207.

Duarte C.M. 1991. Seagrass depth limits. *Aquatic Botany* 40: 363-377.

Duarte C.M. and Chiscano C.L. 1999. Seagrass biomass and production: a reassessment. *Aquatic Botany* 65: 159-174.

Falkowski P.G. and Raven J.A. 1997. 'Aquatic Photosynthesis.' (Blackwell Science: USA).

Fourqurean J.W., Boyer J.N., Durako M.J., Hefty L.N. and Peterson B.J. 2003. Forecasting responses of seagrass distributions to changing water quality using monitoring data. *Ecological Applications* 13: 474-489.

Fourqurean J.W. and Zieman J.C. 1991. Photosynthesis, respiration and whole plant carbon budget of the seagrass *Thalassia testudinum*. *Marine Ecology Progress Series* 69: 161-170.

Gabric A.J. and Bell P.R.F. 1993. Review of the effects of non-point nutrient loading on coastal ecosystems. *Australian Journal of Marine and Freshwater Research* 44: 261-283.

Gaetjens A. 2005. The impact of increased turbidity on *Amphibolis* and *Posidonia*. Honours Thesis. University of Adelaide 84pp.

Herzka S.Z. and Dunton K.H. 1997. Seasonal photosynthetic patterns of the seagrass *Thalassia testudunum* in the western Gulf of Mexico. *Marine Ecology Progress Series* 152: 103-117.

Herzka S.Z. and Dunton K.H. 1998. Light and carbon balance in the seagrass *Thalassia testudinum*: evaluation of current production models. *Marine Biology* 132: 711-721.

Holmer M. and Bondgaard E.J. 2001. Photosynthetic and growth response of eelgrass to low oxygen and high sulphide concentrations during hypoxic events. *Aquatic Botany* 70: 29-38.

Kennish M.J. 1989. Practical handbook of marine science. CRC Press. Boston.

Livingston R.J., McGlynn S.E. and Niu X. 1998. Factors controlling seagrass growth in a gulf coastal system: Water and sediment quality and light. *Aquatic Botany* 60: 135-159.

Longstaff B.J. and Dennison W.C. 1999. Seagrass survival during pulsed turbidity events: the effects of light deprivation on the seagrasses *Halodule pinifolia* and *Halophila ovalis*. *Aquatic Botany* 65: 105-121.

Lüder U.H., Wiencke C. and Knoetzel J. 2002. Acclimation of photosynthesis and pigments during and after six months of darkness in *Palmaria decipiens* (Rhodophyta): a study to simulate Antarctic winter sea ice cover. *Journal of phycology* 38: 904-913.

Macinnis-Ng, C.M.O. and Ralph, P.J. 2004. In situ impact of multiple pulses of metal herbicide on the seagrass, *Zostera capricornii*. *Aquatic Toxicology* 67: 227-237.

Major K.M. and Dunton K.H. 2000. Photosynthetic performance in *Syringodium filiforme*: seasonal variation in light-harvesting characteristics. *Aquatic Botany* 68: 249-264.

Major K.M. and Dunton K.H. 2002. Variations in light-harvesting characteristics of the seagrass, *Thalassia testudinum*: evidence for photoacclimation. *Journal of Experimental Marine Biology and Ecology* 275: 173-189.

Masini R.J., Cary J.L., Simpson C.J., McComb A.J. 1990. Effects of light and temperature on the photosynthesis of seagrasses, epiphytes and macroalgae and implications for management of the Albany harbours. (Environmental Protection Authority Technical Series, 32.) Environmental Protection Authority, Perth, WA. 21pp.

Masini R.J., Cary J.L., Simpson C.J. and McComb A.J. 1995a. Effects of light and temperature on the photosynthesis of temperate meadow-forming seagrasses in Western Australia. *Aquatic Botany* 49: 239-254.

Masini, R. J., Burt, J. S., and Simpson, C. J. 1995b. Light and *Posidonia* seagrass meadows in the temperate coastal waters of Western Australia. 3. Minimum light requirements. Western Australia Department of Environmental Protection Technical Series No. 65. 17 pp.

Masini R.J. and Manning C.R. 1997. The photosynthetic responses to irradiance and temperature of four meadow-forming seagrasses. *Aquatic Botany* 58: 21-36.

Masini R.J. and van Senden D.C. 1995. Development, parameterisation and calibration of a *Posidonia sinuosa* growth simulation model using laboratory and field data. Department of Environmental Protection, Perth, Western Australia. Technical Series 74.

Mazzella L. and Alberte R.S. 1986. Light adaptation and the role of autotrophic epiphytes in primary production of the temperate seagrass, *Zostera marina* L. *Journal of Experimental Marine Biology and Ecology* 100: 165-180.

Orth R.J. and Moore K.A. 1983. Chesapeake Bay: an unprecedented decline in submerged aquatic vegetation. *Science* 222: 51-53.

Pattiaratchi C. and R. Jones (2005). Physical and oceanographic studies of Adelaide coastal waters using high resolution modeling, in-situ observations and satellite techniques – PPM 2 Sub Task 4 Draft Final Technical Report. ACWS Technical Report No. 8 prepared for the Adelaide Coastal Waters Study Steering Committee. Centre for Water Research, University of Western Australia, Nedlands WA 6907. July 2005.

Pérez M. and Romero J. 1992. Photosynthetic response to light and temperature of the seagrass *Cymodocea nodosa* and the prediction of its seasonality. *Aquatic Botany* 43: 51-62.

Phillips D.M. and Scholz M.L. 1982. Measured distribution of water turbidity in Gulf St Vincent. *Australian Journal of Marine and Freshwater Research* 33: 723-737.

Raven J.A. 1994. The cost of photoinhibition to plant communities. *In: Photoinhibition of photosynthesis: From molecular mechanisms to the field*. (Eds NR Baker and JR Bowyer) pp. 449-464. (BIOS Scientific Publishers Ltd: Oxford).

Ruiz J.M. and Romero J. 2001. Effects of *in situ* experimental shading on the Mediterranean seagrass *Posidonia oceanica*. *Marine Ecology Progress Series* 215: 107-120.

Ruiz J.M. and Romero J. 2003. Effects of disturbances caused by coastal constructions on spatial structure, growth dynamics and photosynthesis of the seagrass *Posidonia oceanica*. *Marine Pollution Bulletin* 46: 1523-1533

Seddon S. 2002. Issues for seagrass rehabilitation along the Adelaide metropolitan coast: An overview. *In:* Seddon S. and Murray-Jones S. Eds. *Proceedings of the seagrass restoration workshop for Gulf St Vincent 15-16 May 2001*. Department of Environment and Heritage and SARDI Aquatic Sciences, Adelaide, pp. 1-8.

Shepherd S.A., McComb A.J., Bulthuis D.A., Neverauskas V.P., Steffensen D.A. and West R. 1989. Decline of seagrasses. *In:* Larkum A.W.D., McComb A.J. and Shepherd S.A. Eds. *Biology of seagrasses*. Elsevier, Amsterdam, pp. 346-388.

Short, F.T. and Wyllie-Echeverria, S. 1996. Natural and human induced disturbances of seagrasses. *Environmental Conservation*. 23: 17-27.

Tanner J. 2005. Three decades of habitat change in Gulf St Vincent, South Australia. *Transactions of the Royal Society of South Australia* 129: 65-73.

Titlyanov E.A., Leletkin V.A., Bil K.Y., Kolmakov P.V. and Nechai E.G. 1992. Light and temperature dependence of oxygen exchange, carbon assimilation and primary production in *Thalassodendron ciliatum* blades. Atoll Research Bulletin No 375. National Museum of Natural History. Smithsonian Institute. Washington.

Touchette B.W. and Burkholder J.M. 2000. Overview of the physiological ecology of carbon metabolism in seagrasses. *Journal of Experimental Marine Biology and Ecology* 250: 169-205.

Vermaat J.E., Agawin N.S.R., Fortes M.D., Uri J.S., Duarte C.M., Marbà N., Enriquez S. and van Vierssen W. 1996. The capacity of seagrasses to survive increased turbidity and siltation: The significance of growth form and light use. *Ambio* 25: 499-504.

Westphalen G., Collings G., Wear R., Fernandes M., Bryars S. and Cheshire A. 2005. *"A review of seagrass loss on the Adelaide metropolitan coastline".* Adelaide Coastal Waters Study Technical Report No. 2 prepared for the Adelaide Coastal Waters Study Steering Committee. South Australian Research and Development Institute (Aquatic Sciences) Publication No. RD04/0073, Adelaide.

Wilkinson J. 2005. *"Reconstruction of historical stormwater flows in the Adelaide metropolitan area"*. ACWS Technical Report No. 10 prepared for the Adelaide Coastal Waters Study Steering Committee, September 2005. Department of Environmental Health, Flinders University of SA.

Zimmerman R.C. 2006. Light and Photosynthesis in Seagrass Meadows *In* Larkum A.W.D., Orth R.J. and Duarte C.M. Eds. Seagrasses: Biology, Ecology and Conservation. Springer Verlag, Netherlands. pp. 303-321.

Science of the Total Environment 813 (2022) 152646

Contents lists available at ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

Research Paper

Landsat historical records reveal large-scale dynamics and enduring recovery of seagrasses in an impacted seascape

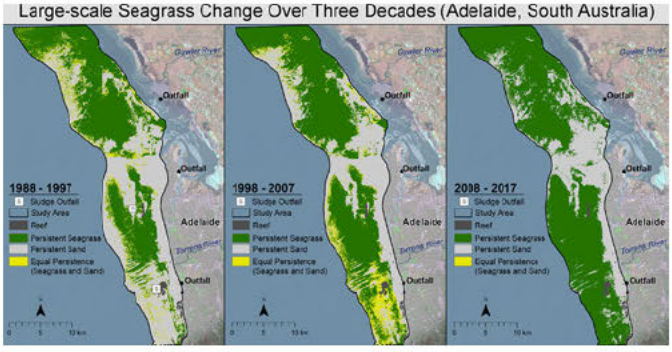
Milena B. Fernandes [a,b], Andrew Hennessy [c], Wallace Boone Law [c], Robert Daly [a], Sam Gaylard [d], Megan Lewis [c], Kenneth Clarke [c,*]

[a] SA Water, GPO Box 1751, Adelaide, SA 5001, Australia
[b] College of Science and Engineering, Flinders University, GPO Box 2100, Adelaide, SA 5001, Australia
[c] School of Biological Sciences, The University of Adelaide, Adelaide, SA 5005, Australia
[d] South Australian Environment Protection Authority, GPO Box 2607, Adelaide, SA 5001, Australia

HIGHLIGHTS

- Historical Landsat imagery showed large-scale seagrass recovery in South Australia.
- Quick recovery (years) recorded after step-changes in nitrogen and sediment inputs.
- Spatial dynamics modulated by water depth, temporal dynamics by seagrass density.
- Deeper waters (>10 m) had the largest seagrass increases.
- Cover fluctuations suggest vulnerable seagrasses at the edges of the distribution.

GRAPHICAL ABSTRACT



ARTICLE INFO

Article history:
Received 29 September 2021
Received in revised form 2 December 2021
Accepted 19 December 2021
Available online 27 December 2021

Editor: Martin Drews

Keywords:
Change detection
Time series
Remote sensing
Suspended solids
Nitrogen
South Australia

ABSTRACT

Seagrasses are considered indicators of anthropogenic impact but surprisingly little is known about their temporal and spatial dynamics in impacted seascapes. In this study, we used three decades of Landsat imagery (1988–2018) off the coast of Adelaide, South Australia, to investigate how seagrass cover over 501 km^2 responds to changes in land-based inputs, including breakpoints in system trajectory and associated timelags, and the identification of vulnerable meadows. Field data was used to help train benthic classification of summer imagery and define its accuracy. Temporal dynamics of seagrass cover were investigated in relation to annual and multi-year nitrogen and suspended solids loads. Spatial dynamics were inferred from maps of benthic cover persistence and trajectory for each decade. The region experienced a net regrowth of some 11,000 ha of seagrasses since the early 2000s, with the initial large-scale recruitment visible in the imagery 6 years after the closure of sludge outfalls. Seagrass expansion occurred primarily in deeper waters (>10 m) of the central coast and at the seaward edge of the distribution. Recovery continued until 2011 assisted by a window of opportunity created by a decade-long drought and further reductions in nitrogen loads from wastewater treatment plants and industry. Localized seagrass losses however continued to be observed as a result of either permanent or transient increases in suspended solids loads. Seagrass area in the central coast was well correlated ($r^2 = 0.88$) with 5-year running averages of nitrogen and suspended solids loads. Meadows particularly vulnerable to changes in land-based discharges were located at the edges of the distribution, along erosional scarps and at depths >10 m south of the Torrens River. These areas were identified as useful indicators of seagrass status. Overall, seagrass persistence expanded from 48 to 69% of the mapped area, with the region now mostly covered by stable seagrasses.

* Corresponding author.
E-mail address: kenneth.clarke@adelaide.edu.au (K. Clarke).

http://dx.doi.org/10.1016/j.scitotenv.2021.152646
0048-9697/© 2021 Published by Elsevier B.V.

1. Introduction

The last century has seen the rise of large metropolitan centres, with more than 20% of the world's population (1.7 billion people) now living in a city with at least 1 million inhabitants (United Nations, 2018). Approx imately half of these centres are directly dependent on marine resources given their proximity to the coast (<100 km) (Kummu et al., 2016), but their expansion is typically associated with coastal degradation arising from increased ship traffic, dredging, fishing, stormwater and waste dis charges. Regulators monitor habitat condition to inform and manage poten tial impacts, often using seagrasses as indicators of ecological health (Krause Jensen et al., 2005). Seagrasses are not only vulnerable to distur bance, but once lost create negative feedback loops that drive whole re gions to an alternate degraded state (Adams et al., 2016). These changes in turn affect ecosystem services to urban populations including the provi sion of habitat for commercial species, protection of infrastructure from erosion and sea level rise, and improved water quality through nutrient up take and stabilization of sediments (Nordlund et al., 2016).

While seagrasses are typically subject to small scale natural perturba tions resulting from physical disturbance during weather events, large scale dynamics driven by anthropogenic pressures are not well understood (Kendrick et al., 2018). A global trajectory of decline since the 1880s re sulted in the overall loss of 19% of the area of surveyed meadows (Dunic et al., 2021; Waycott et al., 2009) and shows strong association with de structive demersal fishing and seasonal pulses of turbidity (Turschwell et al., 2021). At local scales, loss is typically attributed to water quality (par ticularly nutrient loading) and coastal development although only 10% of studies recently reviewed by Dunic et al. (2021) had enough data to apply inferential statistics in the identification of the cause of change. Re cent trend reversal in several locations in both the US (Lefcheck et al., 2018; Tomasko et al., 2018) and Europe (Carmen et al., 2019; Reise and Kohlus, 2008) are evidence of the importance of managing inputs from land in the local context (Dunic et al., 2021; Turschwell et al., 2021).

Seagrass research to date however has been mostly based on in situ sur veys over small areas (m^2 scale) resulting in poor spatial representation and hindering extrapolation to the landscape context (km^2 scale). The develop ment of remote sensing platforms provides a pathway to break this barrier of scale in ecological studies (Orth et al., 2019). The Landsat program in particular is unique in its temporal continuity and global coverage enabling the reconstruction of historical change over several decades (Wulder et al., 2019; Young et al., 2017). Landsat imagery with well described and in creasingly consistent geometric and radiometric characteristics is available since 1972, with a revisit frequency of 16 days and sometimes more fre quently in periods covered by multiple Landsat sensors.

The early Landsat sensors had low spectral (4 broad bands), spatial (60 m) and radiometric resolution (6 bit) but these were improved (7 bands, 30 m, 8 bit) in the Thematic Mapper (TM) sensors onboard Landsat 4 (1982 1993) and Landsat 5 (1984 2013) and in the Enhanced Thematic Mapper plus (ETM+) sensor onboard Landsat 7 (1999 present). The launch of Landsat 8 (2013 present) and its Operational Land Imager (OLI) sensor resulted in the inclusion of blue and cirrus channels and 12 bit radiometric resolution (Wulder et al., 2019). In addition to Landsat, data from several satellite sensors have become available since the late 1990s with potential for use in seagrass mapping. These include high (<5 m, e.g. WorldView 3, IKONOS), medium (<100 m, e.g. SPOT5, Sentinel 2) and low (>100 m, e.g. MODIS, MERIS) spatial resolution sensors, including some with hyperspectral capability (e.g. Hyperion, EnMap) (Hossain et al., 2015b; Transon et al., 2018; Veettil et al., 2020). These more recent sensors how ever lack the temporal coverage of Landsat, and the costs of acquisition and/or processing are still prohibitive for inclusion of high resolution and/or hyperspectral imagery into management programs (Hossain et al., 2015b).

The application of Landsat data in long term time series analysis has be come more common after the Landsat archive became free and open in 2008, but the vast majority of studies is still restricted to change in terres trial land cover and land use (Zhu, 2017). Investigations of seagrass dynamics are comparatively few and generally focused on shallow (< 10 m) waters (Chen et al., 2016; Hossain et al., 2015a; Hossain et al., 2019; Knudby et al., 2010; Lyons et al., 2013; Strydom et al., 2020). The available studies highlight the usefulness of Landsat imagery to map seagrass extent against bare sand but suggest classification uncertainty in the distinction of coral, algae or muddy substrates, particularly where hab itat patches are smaller than the Landsat pixel. Lyons et al. (2013) found that intra annual variability of seagrass cover was small in comparison to inter annual variability, providing support for the use of annual imagery to detect anthropogenic trends independently of seasonality. Their work was the first to explicitly link large scale variations in seagrass density to in ternal fluctuations or seagrass loss depending on the physical setting. Hossain et al. (2019) reinforced the importance of context in the chain of possible effects, linking erosion of mudflats and increased turbidity to accel erating rates of seagrass loss as a result of land reclamation. Previous re search along the coast of metropolitan Adelaide, South Australia, also identified that localized physical conditions can create positive or negative feedback loops leading to either seagrass loss or gain (van Gils et al., 2017) but supporting evidence from large scale and long term patterns of benthic cover change here and throughout most of Southern Australia have not been quantified until now.

This study analysed annual Landsat imagery between 1988 and 2018 to determine the temporal and spatial dynamics of seagrasses in Adelaide. Seagrass change in the region has been recorded since the 1940s from aerial photography surveys. Up to the late 1990s surveys were designed to cap ture development on land, and their opportunistic use for the assessment of coastal impacts was therefore restricted in spatial extent to the nearshore. Subsequent surveys targeting the coastal environment varied in the area surveyed, instrumentation and methodology used, making it difficult to compare change across multiple years and restricting the analysis to the cal culation of change over two consecutive points in time. The low frequency and irregularity of these surveys (5 16 years) thus hindered the use of the data to pinpoint trends and the failure or success of management actions. The study described here targeted these shortfalls through the classification of annual Landsat imagery in an area covering 501 km^2 of waters up to 17 m in depth over three decades. Temporal dynamics were investigated in terms of annual changes in seagrass area, and spatial dynamics in terms of decadal seagrass cover persistence and trajectory. The main objec tives were to (1) determine if changes in land based inputs could be clearly linked to changes in seagrass cover in time and space, (2) identify breakpoints in system trajectory and associated timelags and (3) distinguish resilient versus vulnerable meadows.

2. Methods

2.1. Study area

Seagrasses are widespread in South Australia, covering in excess of 10,000 km^2 (Jones et al., 2019). More than half of this area is found in the embayments of Gulf St Vincent (1500 km^2) and Spencer Gulf (3700 km^2) (Edyvane, 1999). The city of Adelaide is located in eastern Gulf St Vincent (Fig. 1) and comprises 1.7 million inhabitants or ~ 90% of South Australia's population. Seagrasses here form large meadows along the northern and central shores, where *Posidonia* is the dominant genus followed by *Amphibolis* (Bryars and Rowling, 2009; Clarke et al., 2018). Land inputs to this part of the coast include the wastewater treat ment plants (WWTPs) of Glenelg and Bolivar, the Torrens and Gawler riv ers, and the now decommissioned Penrice soda ash factory discharging in the Port River (Wilkinson et al., 2005) (Fig. 1). These point sources have led to a reduction in light availability to seagrasses through the growth of epiphytes on leaves and an increase in suspended solids (SS) in the water column (Fox et al., 2007). Aerial photography surveys indicate seagrass loss in excess of 6500 ha since the 1940s (Tanner et al., 2014) but this figure is likely a conservative estimate given the limited spatial extent of earlier surveys. Seagrass loss followed population growth with the rate of loss reaching a peak in the 1970s (Fernandes et al., 2019; Fox et al., 2007).

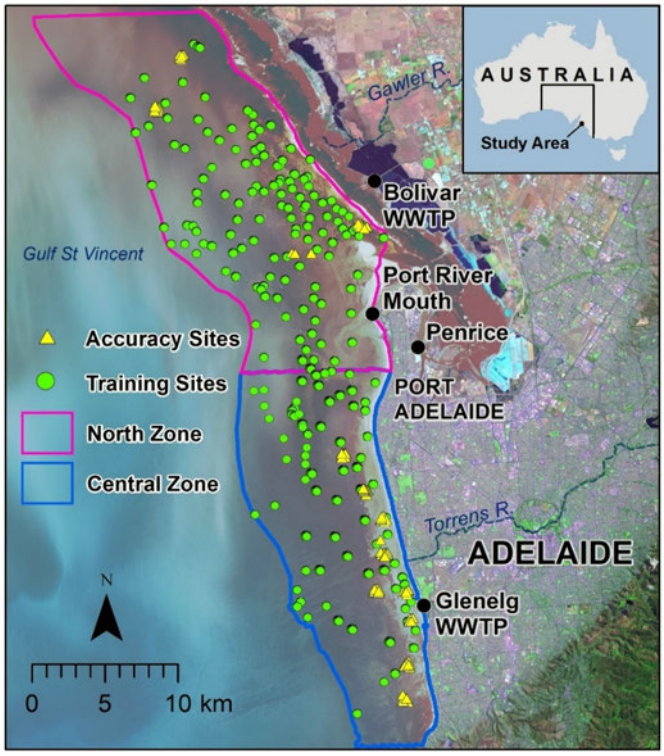


Fig. 1. Study area in Adelaide, South Australia, including sites used for training benthic cover classification, and field survey sites used for accuracy assessment. Base map images: Landsat-8 (ocean) and Sentinel-2 (land).

Localized seagrass loss continued in the 1980s and 1990s but the trend slowed in the 2000s, with the first signs of recovery starting to appear in aerial imagery from 2013 (Hart, 2013).

2.2. Field data

Nineteen sites were surveyed in the spring of 2011 and repeated in 2017 as part of a monitoring program by the South Australian EPA (Environment Protection Authority). Sites were selected by random sampling design using a 500 × 500 m grid overlayed on bathymetry (Gaylard et al., 2013). At each 20 ha site, 10 random underwater video transects (50 130 m) were surveyed, generating a dataset of 190 video transects in total per year. Transects were undertaken using a geo referenced 450 line analogue video camera (Scielex) angled at 90 degrees to the seafloor. A live video feed to a surface screen viewed by a trained operator ran directly from the camera into an audio and video encoding system (Geostamp) which overlays location, direction and speed as well as date and time strings to the video and on a hard drive. Location was derived from the built in GPS in the boat chartplotter (either SIMRAD Evo3 or Raymarine e series, positional accuracy ±3 m). The set up of the camera allowed classification of cover over 1 m increments. As discrimination of seagrass from sand is only accurate at medium to high density cover (Hossain et al., 2015b), we used 2 classification categories: sand (<30% seagrass cover) or seagrass (>30%). Mean cover was post processed in 50 m segments to account for Landsat pixel size (30 m) and transect positional uncertainty (conservatively estimated as 10 m based on boat GPS and variable camera distance from boat).

2.3. Imagery

Landsat archives (https://earthexplorer.usgs.gov/) were searched for imagery covering Adelaide (path 97, row 84) in the warmer months of the year (November March). This period was selected to represent peak seagrass biomass and referred to here as 'summer'. Imagery of adequate quality (no cloud cover, low turbidity) was obtained for 21 of the 30 years (Table S1). Data were converted to top of atmosphere reflectance (ACOLITE, 2019). The processing method for Landsat 5 and 7 vs Landsat 8 imagery (Fig. S1) differed due to differences in radiometric resolution between TM/ETM+ and OLI sensors. The first four bands of Landsat 8 imagery were used (Table S2), but only the blue band of Landsat 5 and 7. This was because the green band of TM/ETM+ data was noisy, and the dynamic range was greatly reduced in the red band. Based on visual inspection of water clarity, one image in each summer was selected from the Landsat 5 and 7 archives, while all clear images were used for Landsat 8. Total suspended solids (SS) concentration was calculated for each Landsat 8 image using the red band (Nechad et al., 2010). A composite image for each summer was then created where the reflectance of each pixel was inversely weighted to its calculated SS from each image (i.e. providing greater weight to images with lowest SS). The four reflectance bands of the composite image were used to run a principal component analysis (PCA) and extract 4 principal components (PCs). The four bands were also depth corrected (Lyzenga, 1981) and illumination normalised (Pu et al., 2012). A band stack was then created for each year (Table S2).

2.4. Benthic classification

As light absorption in the water column changes the appearance of cover classes with depth (e.g. sand in deeper waters appears darker than dense seagrass in very shallow waters), the blue band of Landsat 5 and Landsat 7 images was subset into areas where sand and seagrass could be clearly distinguished (i.e. the brightest area of dense seagrass was darker than the darkest area of sand). This process was based on trial and error, and examination of areas of obvious over and under classification. Each subset area was then density sliced in ENVI 5.5 with a brightness threshold visually assessed to minimise misclassification. All subsets were merged back together to form the raw benthic exposure map for that year.

Landsat 8 band stack images were classified using Support Vector Machine (SVM) supervised classification (Cortes and Vapnik, 1995) adopting a linear kernel algorithm and default hyperparameters in ENVI 5.5. Field data was studied by the user to learn the appearance of target classes but not used for training classifications. Training areas of 5 × 5 pixels remote from field data were defined for each substrate class based on user interpretation until approximately 1500 3000 pixels (i.e. 60 120 distinct areas) had been selected (more for images with higher within and between class variability).

All benthic classifications were further corrected for improbable temporal behaviour. Benthic maps within each decade were combined into a temporal stack, and each pixel was examined for change in cover type on a single date, excluding the first or last image date in that decade. For instance, if a pixel was classed as seagrass in all years except year 7, the classification as sand in that year was considered unlikely and re labelled to seagrass. As images extended over two calendar years (November March), maps were assigned to the year when summer started (e.g. data for 2017/18 was labelled as 2017), allowing comparison of seagrass cover to land based inputs for that year.

2.5. Accuracy assessment

Accuracy assessments were based on field data reserved for this purpose. Homogenous field data transect segments 50 m long were identified for each cover type, including 43 sand and 84 seagrass segments in 2011, and 67 sand and 56 seagrass segments in 2017. Accuracy was evaluated by comparing the centre points of these transect segments to the final mapped cover class. Spatial accuracy statistics were computed, including overall accuracy (% of reference sites mapped correctly), Producer's accuracy (% of real features on the ground mapped correctly) and User's accuracy (% of each map class that will be correct on the ground), as well as Cohen's kappa coefficient (probability of chance agreement between field and mapped data, with 0 indicating no more agreement than expected due to chance, and 1 complete agreement) (Congalton and Green, 2019).

2.6. Decadal products

Temporal maps of benthic cover persistence and trajectory were created for each decade. Processing was performed in Python 3.7.1, predominantly using numpy, GDAL and rasterio libraries. Persistence was calculated as the most frequent benthic cover for each pixel within a decade. Trajectory was calculated for each pixel as an increase or decrease in cover, no change, or too variable to detect trends in time. If a pixel changed state once (e.g. from sand to seagrass) and remained in the new state it was assigned to a change class (e.g. seagrass gain). If a pixel did not change state it was assigned to a static class (e.g. sand no change). If a pixel changed states multiple times, it was not possible to determine a temporal trajectory, and it was assigned to the class labelled as no clear trend.

Each of the decadal products condenses critical spatial information into a single map, losing fine temporal resolution. To enable evaluation of year on year changes, we calculated change in seagrass cover stratified by reporting zone and year. Two zones (north and central) were considered based on distance to point sources (Fig. 1), following the approach of earlier local studies (Fox et al., 2007; van Gils et al., 2017). Mapping outside of these zones, including in the south, was excluded due to consistent high tur bidity and wave action nearshore or deep waters offshore.

2.7. Land based inputs

Seagrass cover was compared to land based nitrogen and SS loads. Wastewater treatment plant inputs from 1978 to 1994 were reconstructed from state agencies' reports and paper records of flows and concentrations compiled during the Adelaide Coastal Waters Study (ACWS) (Wilkinson et al., 2003; Wilkinson et al., 2005). Wastewater treatment plant inputs from 1995 were routinely measured by SA Water. Industrial inputs were de rived from compliance data reported by the Penrice soda ash factory to the South Australian EPA and the National Pollutant Inventory (McDowell and Pfennig, 2013; National Pollutant Inventory, 2020; van Gils et al., 2017). Inputs for the Torrens River (from 1997) and Gawler River (from 2009) were compiled from data collected by the Adelaide and Mount Lofty Ranges Natural Resources Management Board (Water Data Services, 2015; Water Data Services, 2020). Historical river inputs from earlier years were estimated in a catchment model implemented in SOURCE, where rainfall runoff was simulated using SIMHYD and calibrated to local data, and constituent generation was based on locally derived event mean concentra tions (EMC) and dry weather concentrations (DWC) (Rouse et al., 2016). In sub catchments where local data was absent, the model used EMC/DWC values for Australian rural (Fleming et al., 2010) and urban land uses (Fletcher et al., 2004).

2.8. Data analysis

Multiple linear regression was used to investigate if seagrass area was correlated with nitrogen and SS loads and their cumulative impact over sev eral years. The limited availability of water quality data in the 1980s and 1990s meant loads simulated for this period were highly dependent on measured flows, and nitrogen and SS loads could not be considered inde pendent variables. The dataset used in the multiple linear regression was thus selected to include running averages calculated over the period when regular monitoring data was available for all sources. For the central zone, the time period used was 2005 to 2017 to allow calculation of run ning averages over 8 years dating back to 1997, when data for the Torrens River started to be collected. Monitoring data for all sources in the north zone only became available in the late 2000s and the dataset could not be used with confidence in the analysis.

3. Results

Benthic classification was very accurate, with a higher Cohen's kappa coefficient in 2017 (0.90) than 2011 (0.62) (see also Table 1). Misclassifica tion errors appeared mostly as sand sites classified as seagrass but were typically transient. Classification was challenging in areas showing recur ring periods of high turbidity particularly near the Port River shipping channel and offshore in the northwest (Fig. 1).

Table 1
Confusion matrix and classification accuracy for benthic cover mapping.

Mapped cover	Reference (field) data			User's accuracy (%)
	Sand	Seagrass	Total	
Year 2011				
Sand	33	12	45	73
Seagrass	10	72	82	88
Total	43	84	127	
Producer's accuracy (%)	77	86		
Overall accuracy (%)	83			
Year 2017				
Sand	61	0	61	100
Seagrass	6	56	62	90
Total	67	56	123	
Producer's accuracy (%)	91	100		
Overall accuracy (%)	95			

The largest changes in seagrass area were recorded in the central coast (Fig. 2, right panel). A step change in loads occurred with the closure of two sludge outfalls in 1993 leading to a reduction of 5200 t SS and 380 t N per year, followed by a gradual decline of nitrogen discharges from the Glenelg WWTP until 2011. A dramatic increase in seagrass area of over 8000 ha was observed between 1999 and 2004 (Fig. S2a), set back by losses of approxi mately 2000 ha in the next 3 years (Fig. S2b). The Torrens River discharged 4651 t SS in 2005 and high turbidity prevented imagery classification in both 2005 and 2006 (Table S1). Further gains of over 2500 ha were re corded between 2007 and 2011 (Fig. S2c). A decade long drought ended in 2010, increasing the annual SS load discharged by the Torrens River from a median value of 558 t during the drought (2001 2009) to 1555 t af terwards. Approximately 1000 ha of seagrasses were lost from the central coast since 2011 (Fig. S2d) with cover stabilizing around 16,000 ha (Table S3). Five years running averages of nitrogen loads in particular, and to a lesser extent SS loads, were good predictors of seagrass area in this zone since the mid 2000s (Table 2), with regression coefficients sug gesting the impact of nitrogen to have been more than 17× higher than SS.

Seagrass cover in the north (Fig. 2, left panel) was comparatively more stable than in the central coast, fluctuating around 18,000 ha. The lowest values in the first decade (~16,000 ha) were recorded after the floods of 1992 and 1996 (Table S3). Inputs from the 1996 flood were compounded by transient increases of WWTP and industry loads in 1996 1998. Seagrass area after both the 1992 and 1996 events however started to recover as soon as loads dropped. The upgrade of the Bolivar WWTP to activated sludge treatment (2001) and installation of sediment settlement ponds at the soda ash factory in the Port River (2002) led to a reduction of inputs in the order of 4000 t SS and 1200 t N per year by 2003. Seagrass cover however was relatively stable or even decreased in some areas until 2007 (Fig. S2b). Region wide patchy regrowth (~ 4000 ha) followed until 2011 (Fig. S2c) but was subsequently lost (Fig. S2d) with cover remaining stable since 2013 (Table S3). Suspended solids discharges from the soda ash factory increased by some ~8000 t in the late 2000s to reach a peak in 2011 and remained high until its closure in 2013. Satellite imagery in 2012 was too turbid for benthic cover classification (Table S1).

While the analysis of annual changes highlights major temporal shifts in the system, the analysis of decadal products allows interpretation of long term spatial dynamics. In 1988 1997, persistent seagrass covered a similar proportion of the classified area (48%) as persistent sand (44%) (Fig. 3a; Table S4). Sand cover was particularly prevalent around the Port River shipping channel and inshore south of the mouth, as well as both inshore and offshore south of the Torrens River. Pixels in a trajectory of loss com prised 2053 ha (Table S5), with larger continuous extents in the north (e.g. area a in Fig. 4a). Pixels in a trajectory of gain occupied 1168 ha, mostly scattered gains across the seascape (e.g. areas b and c). Areas show ing no clear trend (15,997 ha) were of the same order of magnitude as areas

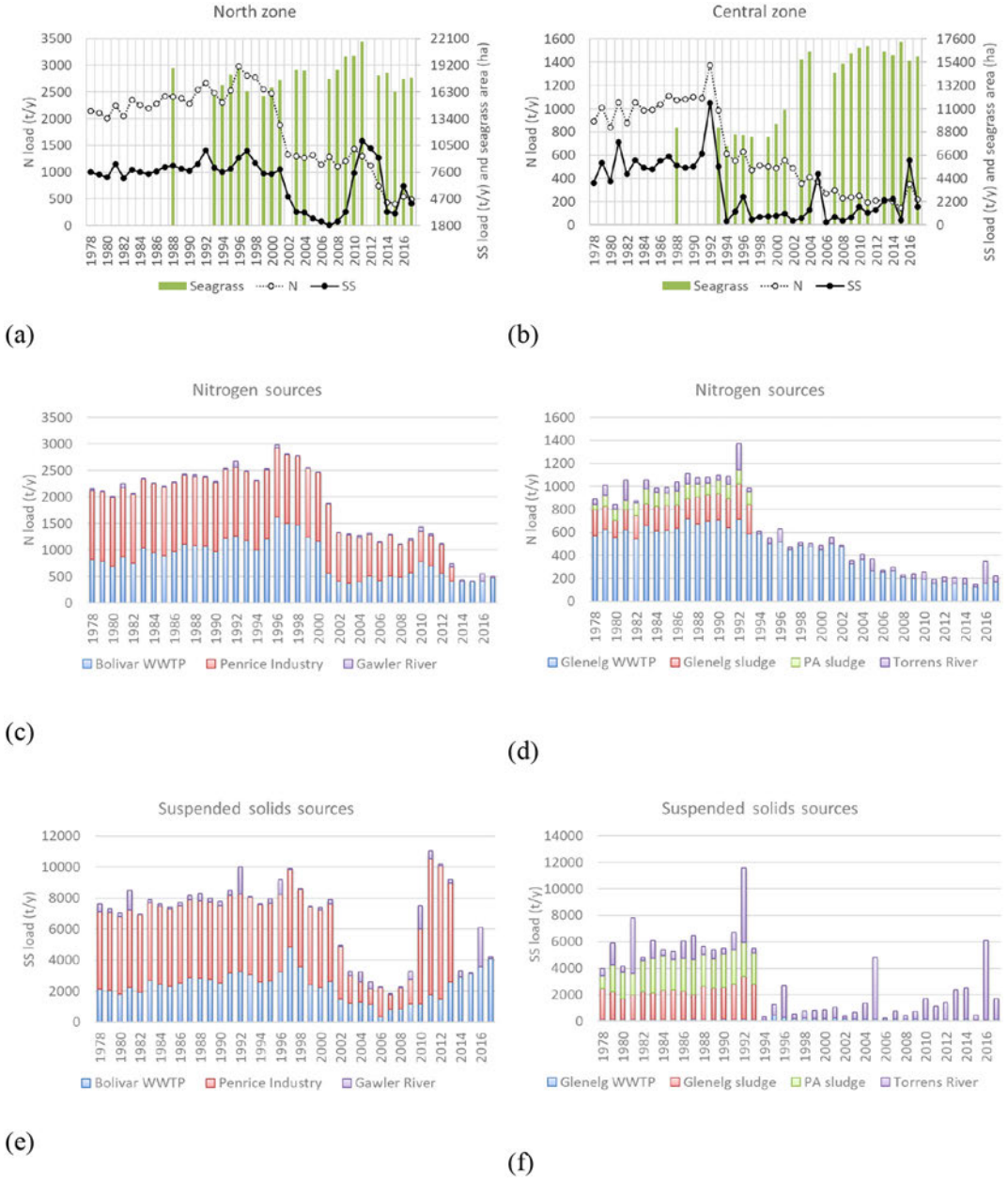


Fig. 2. Seagrass cover (1988–2017) versus land-based inputs (1978–2017) in the north (a) and central zones (b). The middle panel shows sources of nitrogen in the north (c) and central zones (d), while the bottom panel shows sources of suspended solids in the north (e) and central zones (f).

Table 2
Multiple linear regression results between seagrass area (ha) and running averages of loads (t/y) in the central zone for the period 2005–2017: Seagrass area = a × (nitrogen load) + b × (suspended solid load) + c.

Running average (years)	a	b	c	r^2
1	14.91*	+0.26	19,104***	0.62*
2	18.18*	+0.11	20,194***	0.59*
3	20.67**	0.35	21,547***	0.78**
4	16.84***	0.61**	21,185***	0.87***
5	15.89***	0.89**	21,506***	0.88***
6	13.56**	0.98*	21,136***	0.70*
7	12.22*	1.20	21,225***	0.62*
8	10.63*	1.22	20,832***	0.58*

Statistical significance shown as *$p < 0.05$, **$p < 0.01$ and ***$p < 0.001$.

showing no change in sand (14,596 ha) or seagrass (16,278 ha). Sand was persistent in the northwest, and south of the Torrens River (Fig. 3a), but the trajectory analysis suggests these areas had no clear trend in time (Fig. 4a).

In 1998 2007, seagrass persistence increased to 55% of the mapped area while sand persistence decreased to 34% (Fig. 3b; Table S4). The most striking feature of this decade was a trajectory of recovery over 6782 ha, more than 70% of which in the central coast, particularly south of the Torrens River (Fig. 4b; Table S5). The area showing no change in seagrass cover (20,540 ha) was also larger than in the previous decade. This larger extent of recovering and stable seagrasses is balanced by a de crease in areas with no clear trend (10,338 ha) and with no change in sand (11,160 ha). Seagrass loss however was identified in the vicinity of the Port River shipping channel (e.g. areas d and e in Fig. 4b).

In 2008 2017, seagrass persistence increased again to 69% of the mapped area (Fig. 3c; Table S4). This increase was mostly related to the elimination of areas showing equal persistence of sand and seagrass in the

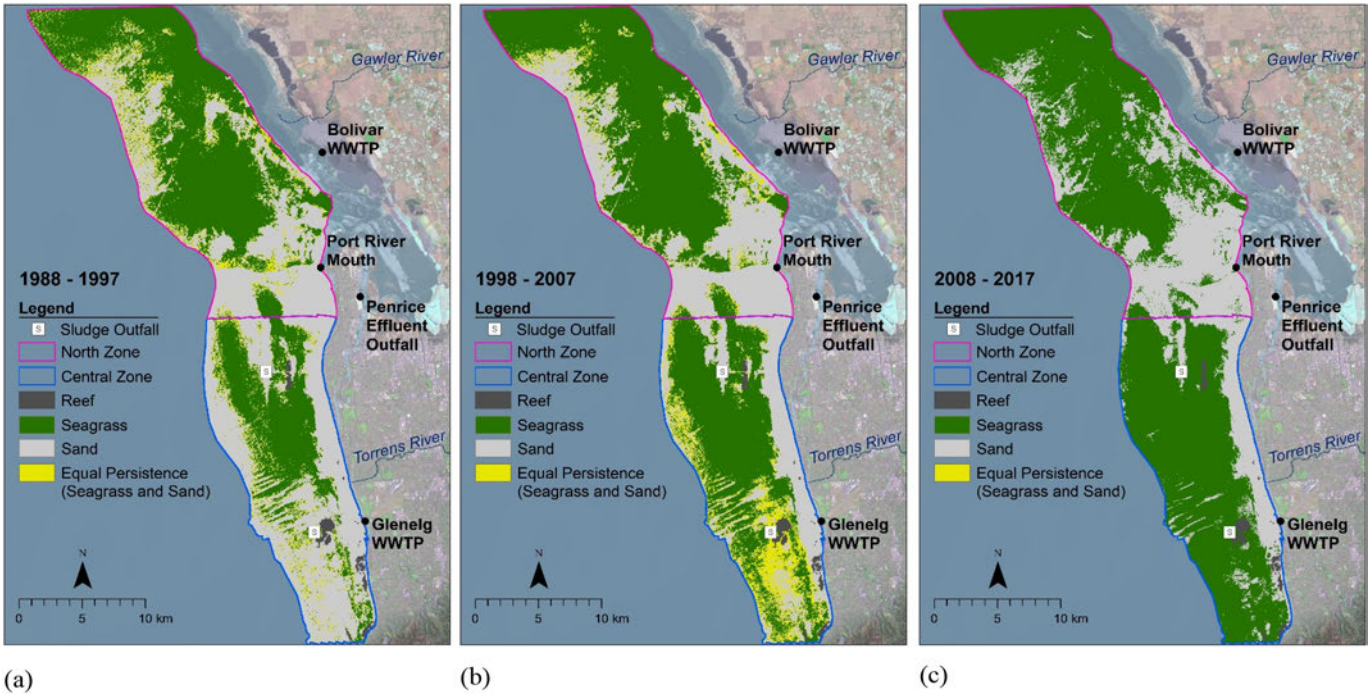


Fig. 3. Benthic cover persistence (seagrass, sand and equal persistence of seagrass and sand) in 1988–1997 (a), 1998–2007 (b) and 2008–2017 (c).

previous decade. The trajectory map (Fig. 4c) identified 27,908 ha as having no change in seagrass cover (Table S5), with stable cover where a trajectory of gain was identified in the previous decade. The area in a trajectory of loss (1406 ha) was close to that in a trajectory of gain (876 ha). The largest area of loss occurred just offshore of the mouth of the Gawler River (area f in Fig. 4c) while gains were identified in erosional scarps at depths >10 m off the Torrens River mouth (e.g. area g in Fig. 4c).

The increase in seagrass persistence between the first and last decade of the study equated to 10,967 ha (Table S4), while the increase in stable seagrass cover was 11,630 ha (Table S5). Errors in classifying static cover types are usually temporally transient and therefore corrected by the time integration included in these decadal products. These values thus suggest an overall net seagrass gain of around 11,000 ha over the study period, approximately 80% of which in the central zone.

4. Discussion

The mapping approach presented here allowed successful benthic classification to derive seagrass trends in space and time over a large management area covering 501 km^2. In a review of seagrass mapping from

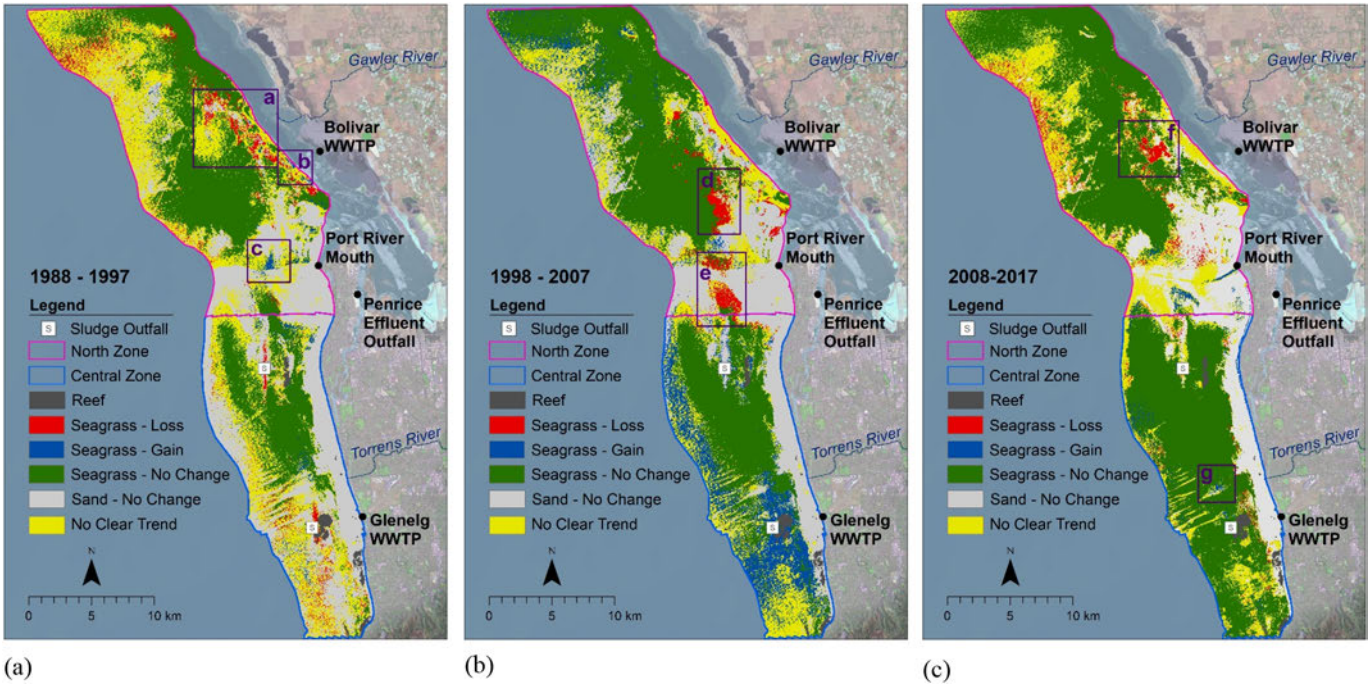


Fig. 4. Benthic cover trajectory in 1988–1997 (a), 1998–2007 (b) and 2008–2017 (c).

remote sensing, Hossain et al. (2015b) indicate the prevalence of much smaller area coverages in the literature (particularly <10 km^2), a fact attrib uted to the early stage of development of applications for subtidal remote sensing, which are generally proof of concept and not yet widely used to address management questions (Goodman et al., 2013). The high accuracy of the benthic classification (>80%) obtained here however was similar or higher than reported for other coastal studies using Landsat data (Hossain et al., 2015a; Lyons et al., 2012), suggesting the feasibility and usefulness of incorporating spaceborne imagery in large scale routine monitoring pro grams. We also show that in systems where water clarity is high and there are no confounding benthic cover types such as mud and macroalgae, accu rate benthic classification can be achieved into waters up to 17 m, consid erably deeper than usually reported in the literature (typically <10 m) (Chen et al., 2016; Hossain et al., 2015a; Hossain et al., 2019; Knudby et al., 2010; Lyons et al., 2013; Strydom et al., 2020).

The increased dynamic range and spectral resolution of Landsat 8 fur ther contributed to increase accuracy through the creation of SS weighted ensemble images corrected for depth and illumination. The methodology relied on manual pixel training based on user interpretation of underwater video data followed by supervised classification. Pixel training and identifi cation of classification thresholds would benefit from automation of image sub setting based on spatially varying physical characteristics (e.g. depth, turbidity), image quality (e.g. illumination) and perhaps also seagrass sta tus (e.g. fragmentation). Classification was particularly challenging in areas of low seagrass density generally causing an upper estimate in the seagrass cover maps, i.e. sites with density < 30% classified as seagrass rather than sand. Short term variations in seagrass density would also influ ence the classification of some areas as having no clear trend in seagrass cover through time (Fig. 4).

Seagrass density further helps explain timelags in detecting seagrass change. Inputs to the north zone drastically decreased between 2000 and 2002 and again between 2012 and 2014 (Fig. 2). Seagrass regrowth post 2002 was observed from 2008 while recovery post 2014 is not yet seen in the data. Similarly, inputs to the central zone significantly decreased be tween 1993 and 1994, followed by a gradual decline of nitrogen discharges until 2011, but seagrass regrowth was only observed from 2000, continuing to reach a peak in 2011. These data show that recovery from bare was only detectable in Landsat imagery after at least 6 years of a step change in in puts. In contrast, regrowth after transient peaks in loads (e.g. large storms) was observed in the imagery much sooner (1 2 years) suggesting that these stochastic events affect the density of seagrasses to a level low enough to be detected as loss but thickening of remaining cover through time ensures quick detection of recovery. This finding is consistent with recent reports from northeast Australia where seagrass area recovers more quickly than biomass after major flood events (Lambert et al., 2021). A sustained in crease of inputs over several years on the other hand caused lasting seagrass loss suggesting not a decrease in density but complete loss of cover, e.g. as observed in the north zone after a peak in industrial discharges in the early 2010s.

The spatial patterns of change were also affected by location, and dis tinct between the north and central zones. In the north zone, seagrasses were absent for a couple of kilometers both north and south of the shipping channel of the Port River, and spatially patchy and temporally variable in both the northwest offshore and nearshore (< 5 m) in a 10 km band cen tered between the Gawler River mouth and the Bolivar WWTP. In the cen tral zone, seagrasses were completely lost from the nearshore in the 1970s (Fernandes et al., 2019; Hart, 1997) and the substrate has remained bare for the past 30 years likely due to wave driven resuspension of fine sediments and low light availability to seagrasses (Fernandes et al., 2018). Seagrasses were also lost in deeper waters of this zone but have largely recovered fol lowing a window of opportunity driven by closure of sludge outfalls and compounded by drought and further improvements in WWTPs.

Overall the Adelaide metropolitan region has experienced unprece dented and enduring seagrass recovery visible in the imagery since the early 2000s, a trend reversal only observed to date in a few other locations worldwide (Carmen et al., 2019; Orth et al., 2019; Tomasko et al., 2018). A net permanent increase in seagrass cover of approximately 11,000 ha be tween the first and last decades of the study demonstrates that large scale seagrass recovery can be achieved in regions dominated by genera consid ered difficult to rehabilitate such as *Posidonia*, which constitutes around 80% of cover in Adelaide (Clarke et al., 2018). Historical field data confirms the dominance of this genus in the recovered areas as early as 2006, partic ularly offshore south of the Torrens River (Bryars and Rowling, 2009). The timescale of recovery observed in Adelaide is in the order of 5 10 years after step changes in inputs, as opposed to several decades or even recalci trant degradation reported for some locations (O'Brien et al., 2018).

After the initial recovery phase in the early 2000s, nitrogen loads have had a much larger impact on seagrass area than SS loads. Seagrass gain followed consistently declining nitrogen loads in the central zone, while seagrass losses were associated with pulses of SS with floods and highlight the importance of this lever in future initiatives to promote seagrass conserva tion. Running averages of loads over 5 years were the best predictors of seagrass area, suggesting that inputs have a legacy effect over multiple years (Lambert et al., 2021; Lewis et al., 2020) in the case of the central coast likely a consequence of the trapping and resuspension of particles in the nearshore with tides and waves (Cronin and van Gils, 2019; Pattiaratchi et al., 2007).

The magnitude of seagrass change was not only impacted by thresholds in water quality derived from land based inputs (Fernandes et al., 2019) but further modulated by other cumulative stressors affecting light availability. For example, losses in the central zone were more prominent after the floods in 2005 in comparison to 2016. The differences are likely related to dredging of approximately 3 million m^3 of sediments from the shipping channel of the Port River in early 2006. Wind driven resuspension (Fernandes et al., 2018) of this material would have contributed to main tain high turbidity along the coast for at least 1 year after the dredging op eration ceased (Table S1). The impact of the 2006 dredging on seagrass area however was not as pronounced in the north zone probably due to mit igating reductions in WWTP and industrial inputs in the early 2000s (Fig. 2) supporting seagrass recovery in the nearshore (Fig. S2b).

The analysis suggests that in situ seagrass monitoring for the early de tection of change and investigation of ecosystem health would benefit from targeting indicator areas most vulnerable to change, i.e. along both the shallow (<5 m) and deep (>15 m) edge of the distribution, along ero sional scarps and mid depths (~10 m) south of the Torrens River. Seagrasses in these areas are the first to be impacted after an increase in in puts (e.g. Fig. S2b,d) and their monitoring would help explain processes as sociated with loss or recovery, including successional changes in species composition, mode of recovery (e.g. seeds, seedlings and/or rhizome exten sion) and transitional or permanent changes in cover or density (Connolly et al., 2018; Kendrick et al., 2018; Lyons et al., 2013). This knowledge in turn would help devise the best approach for rehabilitating areas that were lost and have been bare for the last 30 years such as the very nearshore along beaches in the central zone.

In conclusion, Landsat imagery supported mapping of large scale seagrass distribution up to 17 m water depth with high accuracy (>80%) providing confidence in the identification of seagrass temporal and spatial dynamics over three decades. The resolution of the imagery (30 m) resulted in a delay in detecting seagrass recovery, only visible in the data after at least 6 years of a step change in land based discharges. In contrast, stochas tic events such as storms were likely associated with a transient loss of den sity, allowing recovery detection to start within a year or two. Overall, the Adelaide coast has seen a remarkable and long lasting resurgence of some 11,000 ha of seagrasses concentrated in deeper waters (>10 m) of the cen tral zone, with hyperspectral imagery and field observations suggesting *Posidonia* as the main vector of regrowth. Most of this recovery occurred after closure of sludge outfalls, which combined with the upgrade of WWTPs and severe drought, created a window of opportunity for seagrass regrowth starting in the mid 1990s and lasting for a decade. After that ini tial phase, ongoing nitrogen reductions lead to further seagrass gains but pulses of elevated SS inputs were associated with seagrass loss. Seagrass area was highly correlated (r^2 = 0.88) with 5 year running averages of

nitrogen and SS discharges suggesting their legacy effect over several years. Seagrass cover change was typically seen in areas where seagrasses might be at the extreme of their habitat suitability, such as the edges of the distri bution and erosional scarps. Regular monitoring of these vulnerable areas would help define seagrass status through time and understand mecha nisms associated with either loss or recovery.

Data statement

The datasets generated during the current study are available from the corresponding author on reasonable request, and will be submitted to Figshare.

Declaration of competing interest

The authors declare that they have no known competing financial inter ests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

This project was funded by the South Australian Water Corporation (SA Water). We are grateful to James Cameron (South Australian Department for Environment and Water) for advice on study design, and to Warwick Noble (EPA) for sharing and advising on field datasets.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.scitotenv.2021.152646.

References

ACOLITE, 2019. Acolite. https://odnature.naturalsciences.be/remsem/software-and-data/acolite.

Adams, M.P., Hovey, R.K., Hipsey, M.R., Bruce, L.C., Ghisalberti, M., Lowe, R.J., Gruber, R.K., Ruiz-Montoya, L., Maxwell, P.S., Callaghan, D.P., Kendrick, G.A., O'Brien, K.R., 2016. Feedback between sediment and light for seagrass: where is it important? Limnol. Oceanogr. 61, 1937–1955.

Bryars, S., Rowling, K., 2009. Benthic habitats of Eastern Gulf St Vincent: major changes in benthic cover and composition following European settlement of Adelaide. Trans. R. Soc. S. Aust. 133, 318–338.

Carmen, B., Krause-Jensen, D., Alcoverro, T., Marbà, N., Duarte, C.M., van Katwijk, M.M., Pérez, M., Romero, J., Roca, G., Jankowska, E., J.L. S-L, 2019. Recent trend reversal for declining European seagrass meadows. Nat. Commun. 10, 3356.

Chen, C.-F., Lau, V.-K., Chang, N.-B., Son, N.-T., Chiang, S.-H., 2016. Multi-temporal change detection of seagrass beds using integrated landsat TM/ETM + /OLI imageries in Cam Ranh Bay,Vietnam. Ecol. Inform. 35, 43–54.

Clarke, K., Hennessy, A., Lewis, M., 2018. Adelaide Metropolitan Coastline Benthic Habitat Mapping From Hyperspectral Imagery. Product B: Potential to Differentiate Seagrass Genera and Bare Substrate. Prepared for SA Water, SA Department for Environment and Water, and SA Environmental Protection Authority. School of Biological Sciences, The University of Adelaide, Adelaide, South Australia.

Congalton, R.G., Green, K., 2019. Assessing the Accuracy of Remotely Sensed Data: Principles and Practices. 3rd edn. CRC Press, Boca Raton, Florida.

Connolly, R.M., Jackson, E.L., Macreadie, P.I., Maxwell, P.S., O'Brien, K.R., 2018. Seagrass dynamics and resilience. In: Larkum, A.W.D., Kendrick, G.A., Ralph, P.J. (Eds.), Seagrasses of Australia. Springer, Cham, pp. 197–212.

Cortes, C., Vapnik, V., 1995. Support-vector networks. Mach. Learn. 20, 273–297.

Cronin, K., van Gils, J., 2019. Update of AREM Silt Component. Deltares, Delft, the Netherlands.

Dunic, J.C., Brown, C.J., Connolly, R.M., Turschwell, M.P., Côté, I.M., 2021. Long-term declines and recovery of meadow area across the world's seagrass bioregions. Glob. Change Biol. 27, 4096–4109.

Edyvane, K.S., 1999. Coastal and marine wetlands in Gulf St. Vincent, South Australia: understanding their loss and degradation. Wetlands Ecol. Manag. 7, 83–104.

Fernandes, M.B., Daly, R., van Gils, J., Kildea, T., Caires, S., Erftemeijer, P.L.A., 2018. Parameterization of an optical model to refine seagrass habitat requirements in an urbanized coastline. Estuar. Coast. Shelf Sci. 207, 471–482.

Fernandes, M.B., van Gils, J., Gonzalez, D., Daly, R., Rouse, K., Erftemeijer, P.L.A., 2019. A novel approach to determining dynamic nitrogen thresholds for seagrass conservation. J. Appl. Ecol. 56, 253–261.

Fleming, N.K., Cox, J.W., He, Y., Thomas, S., Frizenschaf, J., 2010. Analysis of total suspended sediment and total nutrient concentration data in the Mount Lofty Ranges to derive event mean concentrations. Technical Report ISBN 978-1-921543-32-6. eWater Cooperative Research, Canberra, Australia.

Fletcher, T., Duncan, H., Poelsma, P., Lloyd, S., 2004. Stormwater flow and quality and the effectiveness of non-proprietary stormwater treatment measures: a review and gap analysis. Technical Report ISBN 1920813136. CRC for Catchment Hydrology, Melbourne, Australia.

Fox, D.R., Batley, G.E., Blackburn, D., Bone, Y., Bryars, S., Cheshire, A., Collings, G., Ellis, D., Fairweather, P., Fallowfield, H., Harris, G., Henderson, B., Kämpf, J., Nayar, S., Pattiaratchi, C., Petrusevics, P., Townsend, M., Westphalen, G., Wilkinson, J., 2007. Adelaide Coastal Waters Study, Final Report, Volume 1, Summary of Study Findings, November 2007 (Prepared for the South Australian Environment Protection Authority). CSIRO Land & Water, Adelaide, South Australia.

Gaylard, S., Nelson, M., Noble, W., 2013. The South Australian Monitoring, Evaluation and Reporting Program for Aquatic Ecosystems: Rationale and Methods for the Assessment of Nearshore Marine Waters. Environment Protection Authority, Adelaide, South Australia.

Goodman, J.A., Purkis, S.J., Phinn, S.R., 2013. Coral Reef Remote Sensing: A guide for Mapping, Monitoring and Management. Springer, Dordrecht.

Hart, D., 1997. Near-shore Seagrass Change Between 1949 and 1996 Mapped Using Digital Aerial Orthophotography, Metropolitan Adelaide Area, Largs Bay-Aldinga, South Australia. A Report Prepared for the South Australian EPA. Department of Environment and Natural Resources, Adelaide, South Australia.

Hart, D., 2013. Seagrass Extent Change 2007-13 - Adelaide Coastal Waters. DEWNR Technical Note 2013/07. Department of Environment Water and Natural Resources, Adelaide, South Australia.

Hossain, M.S., Bujang, J.S., Zakaria, M.H., Hashim, M., 2015a. Application of Landsat images to seagrass areal cover change analysis for Lawas, Terengganu and Kelantan of Malaysia. Cont. Shelf Res. 110, 124–148.

Hossain, M.S., Bujang, J.S., Zakaria, M.H., Hashim, M., 2015b. The application of remote sensing to seagrass ecosystems: an overview and future research prospects. Int. J. Remote Sens. 36, 61–114.

Hossain, M.S., Hashim, M., Bujang, J.S., Zakaria, M.H., Muslim, A.M., 2019. Assessment of the impact of coastal reclamation activities on seagrass meadows in Sungai Pulai estuary, Malaysia, using Landsat data (1994–2017). Int. J. Remote Sens. 40, 3571–3605.

Jones, A.R., Dittmann, S., Mosley, L., Beaumont, K., Clanahan, M., Waycott, M., Gillanders, B.M., 2019. Goyder Institute blue carbon research projects: synthesis report. Technical Report Series No. 19/30. ISSN: 1839-2725. Goyder Institute for Water Research, Adelaide, South Australia.

Kendrick, G.A., Hovey, R.K., Lyons, M., Roelfsema, C., Montoya, L.R., Phinn, S., 2018. Australian seagrass seascapes: present understanding and future research directions. In: Larkum, A.W.D., Kendrick, G.A., Ralph, P.J. (Eds.), Seagrasses of Australia. Structure, Ecology and Conservation. Springer, Cham, pp. 257–286.

Knudby, A., Newman, C., Shaghude, Y., Muhando, C., 2010. Simple and effective monitoring of historic changes in nearshore environments using the free archive of Landsat imagery. Int. J. Appl. Earth Obs. Geoinf. 12, S116–S122.

Krause-Jensen, D., Greve, T.M., Nielsen, K., 2005. Eelgrass as a bioindicator under the European Water Framework Directive. Water Resour. Manag. 19, 63–75.

Kummu, M., De Moel, Hans, Salvucci, Gianluigi, Viviroli, Daniel, Ward, Philip J., Varis, O., 2016. Over the hills and further away from coast: global geospatial patterns of human and environment over the 20th–21st centuries. Environ. Res. Lett. 11, 034010.

Lambert, V., Bainbridge, Z.T., Collier, C., Lewis, S.E., Adams, M.P., Carter, A., Saunders, M.I., Brodie, J., Turner, R.D., Rasheed, M.A., O'Brien, K.R., 2021. Connecting targets for catchment sediment loads to ecological outcomes for seagrass using multiple lines of evidence. Mar. Pollut. Bull. 169, 112494.

Lefcheck, J.S., Orth, R.J., Dennison, W.C., Wilcox, D.J., Murphy, R.R., Keisman, J., Gurbisz, C., Hannam, M., Landry, J.B., Moore, K.A., Patrick, C.J., 2018. Long-term nutrient reductions lead to the unprecedented recovery of a temperate coastal region. Proc. Natl. Acad. Sci. U. S. A. 115, 3658–3662.

Lewis, S., Bainbridge, Z., Stevens, T., Garzon-Garcia, A., Chen, C., Bahadori, M., Burton, J., Rezaei Rashti, M., James, C., Smithers, S., Olley, J., 2020. What's Really Damaging the Reef?: Tracing the Origin and Fate of the Ecologically Detrimental Sediment and Associated Bioavailable Nutrients. National Environmental Science Program Tropical Water Quality Hub, Cairns, Australia.

Lyons, M.B., Phinn, S.R., Roelfsema, C.M., 2012. Long term land cover and seagrass mapping using Landsat and object-based image analysis from 1972 to 2010 in the coastal environment of South East Queensland, Australia. ISPRS J. Photogramm. Remote Sens. 71, 34–46.

Lyons, M.B., Roelfsema, C.M., Phinn, S.R., 2013. Towards understanding temporal and spatial dynamics of seagrass landscapes using time-series remote sensing. Estuar. Coast. Shelf Sci. 120, 42–53.

Lyzenga, D.R., 1981. Remote sensing of bottom reflectance and water attenuation parameters in shallow water using aircraft and landsat data. Int. J. Remote Sens. 2, 71–82.

McDowell, L.-M., Pfennig, P., 2013. Adelaide Coastal Water Quality Improvement Plan (ACWQIP). Environment Protection Authority, Adelaide, South Australia.

National Pollutant Inventory, 2020. www.npi.gov.au Accessed August 2020.

Nechad, B., Ruddick, K., Park, Y., 2010. Calibration and validation of a generic multisensor algorithm for mapping of total suspended matter in turbid waters. Remote Sens. Environ. 114, 854–866.

Nordlund, L.M., Koch, E.W., Barbier, E.B., Creed, J.C., 2016. Seagrass ecosystem services and their variability across genera and geographical regions. PLoS One 11, e0163091.

O'Brien, K.R., Waycott, M., Maxwell, P., Kendrick, G.A., Udy, J.W., Ferguson, A.J., Kilminster, K., Scanes, P., McKenzie, L.J., McMahon, K., Adams, M.P., 2018. Seagrass ecosystem trajectory depends on the relative timescales of resistance, recovery and disturbance. Mar. Pollut. Bull. 134, 166–176.

Orth, R.J., Dennison, W.C., Gurbisz, C., Hannam, M., Keisman, J., Landry, J.B., Lefcheck, J.S., Moore, K.A., Murphy, R.R., Patrick, C.J., Testa, J., 2019. Long-term annual aerial surveys of submersed aquatic vegetation (SAV) support science, management, and restoration. Estuar. Coast. 1–16.

Pattiaratchi, C., Newgard, J., Hollings, B., 2007. Physical oceanographic studies of Adelaide coastal waters using high resolution modelling, in-situ observations and satellite techniques – sub task 2 final technical report. ACWS Technical Report No. 20 Prepared for the Adelaide Coastal Waters Study Steering Committee. School of Environmental Systems Engineering (The University of Western Australia), Crawley, Australia.

Pu, R., Bell, S., Baggett, L., Meyer, C., Zhao, Y., 2012. Discrimination of seagrass species and cover classes with in situ hyperspectral data. J. Coast. Res. 28, 1330–1344.

Reise, K., Kohlus, J., 2008. Seagrass recovery in the northern Wadden Sea? Helgol. Mar. Res. 62, 77.

Rouse, K., Gonzalez, D., Fernandes, M., Maheepala, S., Mirza, F., van Gils, J., Daly, R., He, Y., Cuddy, S., 2016. New modelling capability to target stormwater interventions that support seagrass health along Adelaide's coast. Technical Report Series No. 16, Project U.2.5. Goyder Institute for Water Research, Adelaide, South Australia.

Strydom, S., Murray, K., Wilson, S., Huntley, B., Rule, M., Heithaus, M., Bessey, C., Kendrick, G.A., Burkholder, D., Fraser, M.W., Zdunic, K., 2020. Too hot to handle: unprecedented seagrass death driven by marine heatwave in a world heritage area. Glob. Change Biol. 26, 3525–3538.

Tanner, J.E., Irving, A.D., Fernandes, M., Fotheringham, D., McArdle, A., Murray-Jones, S., 2014. Seagrass rehabilitation off metropolitan Adelaide: a case study of loss, action, failure, and success. Ecol. Manage Restor. 15, 168–179.

Tomasko, D., Alderson, M., Burnes, R., Hecker, J., Leverone, J., Raulerson, G., Sherwood, E., 2018. Widespread recovery of seagrass coverage in Southwest Florida (USA): temporal and spatial trends and management actions responsible for success. Mar. Pollut. Bull. 135, 1128–1137.

Transon, J., d'Andrimont, R., Maugnard, A., Defourny, P., 2018. Survey of hyperspectral earth observation applications from space in the sentinel-2 context. Remote Sens. 10, 157.

Turschwell, M.P., Connolly, R.M., Dunic, J.C., Sievers, M., Buelow, C.A., Pearson, R.M., Tulloch, V.J., Côté, I.M., Unsworth, R.K., Collier, C.J., Brown, C.J., 2021. Anthropogenic pressures and life history predict trajectories of seagrass meadow extent at a global scale. Proc. Natl. Acad. Sci. U. S. A. 118, e2110802118.

United Nations, 2018. The World's Cities in 2018—Data Booklet (ST/ESA/ SER.A/417). Department of Economic and Social Affairs, Population Division, United Nations.

van Gils, J., PLA, Erftemeijer, Fernandes, M., Daly, R., 2017. Development of the Adelaide Receiving Environment Model. Technical Report 1210877-000. Deltares, Delft, the Netherlands.

Veettil, B.K., Ward, R.D., Lima, M.D.A.C., Stankovic, M., Hoai, P.N., Quang, N.X., 2020. Opportunities for seagrass research derived from remote sensing: a review of current methods. Ecol. Indic. 117, 106560.

Water Data Services, 2015. Adelaide Coastal Waters Study: Stormwater Data Audit Report 2015. A Report Prepared for the EPA. Water Data Services, Adelaide, South Australia.

Water Data Services, 2020. https://greenadelaide.waterdata.com.au/ Accessed July 2020.

Waycott, M., Duarte, C.M., Carruthers, T.J.B., Orth, R.J., Dennison, W.C., Olyarnik, S., Calladine, A., Fourqurean, J.W., Heck, K.L., Hughes, A.R., Kendrick, G.A., Kenworthy, W.J., Short, F.T., Williams, S.L., 2009. Accelerating loss of seagrasses across the globe threatens coastal ecosystems. Proc. Natl. Acad. Sci. U. S. A. 106, 12377–12381.

Wilkinson, J., Pearce, M., Cromar, N., Fallowfield, H., 2003. Audit of the quality and quantity of treated wastewater discharging from wastewater treatment plants (WWTPs) to the marine environment. ACWS Technical Report No.1 Prepared for the Adelaide Coastal Waters Study Steering Committee. Department of Environmental Health (Flinders University of South Australia), Adelaide, South Australia.

Wilkinson, J., White, N., Smythe, L., Hutson, J., Bestland, E., Simmons, C., Lamontagne, S., Fallowfield, H., 2005. Volumes of inputs, their concentrations and loads received by Adelaide metropolitan coastal waters. ACWS Technical Report No. 18 Prepared for the Adelaide Coastal Waters Study Steering Committee. Flinders Centre for Coastal and Catchment Environments (Flinders University of SA), Adelaide, South Australia.

Wulder, M.A., Loveland, T.R., Roy, D.P., Crawford, C.J., Masek, J.G., Woodcock, C.E., Allen, R.G., Anderson, M.C., Belward, A.S., Cohen, W.B., Dwyer, J., 2019. Current status of Landsat program, science, and applications. Remote Sens. Environ. 225, 127–147.

Young, N.E., Anderson, R.S., Chignell, S.M., Vorster, A.G., Lawrence, R., Evangelista, P.H., 2017. A survival guide to Landsat preprocessing. Ecology 98, 920–932.

Zhu, Z., 2017. Change detection using landsat time series: a review of frequencies, preprocessing, algorithms, and applications. ISPRS J. Photogramm. Remote Sens. 130, 370–384.

CRITERIA BASED ASSESSMENT OF ADELAIDE BEACH MANAGEMENT REVIEW- SHORTLISTED OPTIONS – ROBYN RAVALICO

COST	OPTION	MAXIMISING SAND STAYING ON BEACHES	MINIMISING DISRUPTION TO ALL COMMUNITIES	AVOIDING ENVIRONMENTAL HARM	Total Score
$45-50 million	1.1 DREDGE EXISTING SAND NEAR SHORE	Correct placement of sand on near shore maximises sand staying on beach, can build beach profile, large mass nourishment delivered in two events, possibly more suitable grain size, adaptable to other erosion hot spots 5	Use of dredge to deliver sand to the near shore lessens disruption for most communities. 4	Identified sand sources will be subject to approval of environmental assessment prior to any works. Dredging activities will be subject to a range of environmental management activities, including turbidity monitoring and pre- and post-dredging seagrass surveys, Dredging performed under EPA guidelines 2020, can be done effectively with limited environmental damage. 4	13
$55-60 million	1.2 DREDGE USING LARGE OFFSHORE SAND DEPOSITS	Correct placement of sand on near shore maximises sand staying on beach can build beach profile, large mass nourishment delivered in two events, possibly more suitable grain size, adaptable to other erosion hot spots	Use of dredge to deliver sand to the near shore lessens disruption for most communities. No need for trucks or heavy equipment on beaches.	Identified sand sources will be subject to approval of environmental assessment prior to any works. Dredging activities will be subject to a range of environmental management activities, including turbidity monitoring and pre- and post-dredging seagrass surveys, Dredging performed under stringent EPA	

		5	4	2020 guidelines can be done effectively with limited environmental damage. 4	13
$60-100 million	1.3 COMBINATION OF DREDGING OFFSHORE & TRUCKING QUARRY SAND	Correct placement of dredged sand on near shore maximises sand staying on beach, can build beach profile. However although quarry sand will possibly have more suitable grain size, the placement of sand on beach face will not maximise sand remaining on beach 5	Use of dredge to deliver sand to the near shore lessens disruption for most communities. However, the delivery of quarry sand via use of trucks are rated as one of the most disruptive to communities. 3	As above. However trucking of quarry sand impacts the beach face environment of recipient beach. This can be especially impactful if the project area is a nesting or foraging area for vulnerable bird species, such as hooded plovers. 3	11
$140-155 million	2.1 PIPELINE USING TRACTORS/TRUCKS ON BEACHES	Placement of sand on beach face, reduces effectiveness of maximising sand staying on beach Smaller grain sized sand than needed. Unsuitable high carbonate composition for pipeline transport. Smaller amounts of sand delivered over time. 1	53% of respondents to ABMR survey were against pipeline. Top responses in survey as the most disruptive to communities was sand management vehicles, trucks, equipment and permanent plant equipment impacting views. Impacts on beach amenity including noise. And smell from machinery plus risk to safety also featured highly. These are all aspects of pipeline, construction and operations. The pipeline option represents the most disruptive features to all	The 14 km HDPE pipeline will result in a large quantity of nano and microplastics being added to the beach environment and gulf waters. Micro and nano plastics particles are included in the EPA definition of pollution causing harm to the environment. Tractors and trucks on the beach cause negative impacts to the infauna and to vulnerable species of birds which use area for foraging and nesting.	

			communities, including the recipient beaches. 1	The high carbonate composition in Northern beach area sands could result in fine suspended sedimentation and cause plumes endangering seagrasses. 0	2
$140-150 million	2.2 PIPELINE USING DREDGE PUMP SYSTEMS ON JETTIES	Placement of sand on beach face, reduces effectiveness of maximising sand staying on beach Smaller grain sized sand than needed. Unsuitable high carbonate composition for pipeline transport. Smaller amounts of sand delivered over time.	53% of respondents to ABMR survey were against pipeline. Top responses in survery to most disruptive to communities was sand management vehicles, trucks, equipment and permanent plant equipment impacting views. Impacts on beach amenity including noise and smell from machinery plus risk to safety also featured highly. These are all aspects of pipeline, construction and operations. Pump systems on jetties will disrupt those who regularly use jetties and beach goers at those beaches.	The 14 km HDPE pipeline will result in a large quantity of nano and microplastics being added to the beach environment and gulf waters. Micro and nano plastics particles are included in the EPA definition of pollution causing harm to the environment. Tractors and trucks on the beach cause negative impacts to the infauna and to vulnerable species of birds which use area for foraging and nesting. The high carbonate composition in Northern beach area sands could result in fine suspended sedimentation and cause plumes endangering seagrasses. Jetties attract a large and varied amount of	

		1	1	marine life. Having dredge pump systems on jetties would severely impact the marine life. 0	2
$140-155 million	2.3 PIPELINE USING DREDGE & TRUCKING QUARRY SAND	Placement of sand on beach face, reduces effectiveness of sand staying on beach Some smaller grain sized sand than needed. Some unsuitable high carbonate composition for pipeline transport. Smaller amounts of sand delivered over time. 1	53% of respondents to ABMR survey were against pipeline. Top responses in survery to most disruptive to communities was sand management vehicles, trucks, equipment and permanent plant equipment impacting views. Impacts on beach amenity including noise. And smell from machinery plus risk to safety also featured highly. These are all aspects of trucking construction and operations 1	The 14 km HDPE pipeline will result in a large quantity of nano and microplastics being added to the beach environment and gulf waters. Micro and nano plastics particles are included in the EPA definition of pollution causing harm to the environment. Tractors and trucks on the beach cause negative impacts to the infauna and to vulnerable species of birds which use area for foraging and nesting. The high carbonate composition in Northern beach area sands could result in fine suspended sedimentation and cause plumes endangering seagrasses. Trucking of quarry sand could impact the nesting and foraging areas of vulnerable bird species. 0	2

$100-110 million	3.0 CARTING – USING TRUCKS & MACHINERY & QUARRY SAND	Placement of sand on beach face reduces effectiveness of maximising sand staying on beaches Quarry sand more suitable size than that from northern area beaches of LB & Semaphore 1	Top responses in survery to most disruptive to communities were sand management vehicles, trucks, equipment and permanent plant equipment impacting views. Impacts on beach amenity including noise. And smell from machinery plus risk to safety also featured highly. Many of these disruptive aspects are features of Option 3 -carting. 1	Trucks and machinery used for carting impact the nesting and foraging area of vulnerable bird species. 2	4

ADELAIDE BEACH MANAGEMENT REVIEW

SHORTLIST OPTIONS

ROBYN RAVALICO

INTRODUCTION

The objective of the Adelaide Beach Management Review was to inquire into how to manage sand on Adelaide's beaches to achieve the following goals

- Minimise disruption for all communities
- Avoid environmental harm
- Maximise sand staying on beaches.

The review was to take into account learnings from international examples of sand management, the community's views of current sand management approaches including trucking and pipeline and what can be learned from the most up to date analysis of climate science in regards to the future management of Adelaide's beaches.

As a member of the Adelaide Coastal Communities Alliance over the last two years I have been involved in research into international best practice in sand management and coastal geomorphology of the Adelaide coastline, organised forums, attended a Building a Sustainable Coastal Future conference and took part in detailed evaluation of possible solutions for managing Adelaide's beaches. The below submission is based on learnings from scientific reports, climate data, conferences and involvement in the Adelaide Beach Management Review as a key stakeholder.

What we know from the analysis of current climate change data.

- **An average sea level rise of 4.5 mm per year**

We know that at present, South Australia has an average of 4.5mm sea level rise which is faster than the global average. "I believe South Australia is projected to see a 50cm sea level rise by the mid-century (since the early 1900s), which is pretty significant. It means Adelaide will more than double its risk of flooding." Dr Graziela Miot da Silva, a senior lecturer at Flinders University's College of Science and Engineering.

- **More frequent low intensity storms**

We know that Adelaide beach coastline has experienced the impacts of more frequent, low intensity storms. Instead of these storms occurring once every three to five years, there are now multiple storms of this intensity every year, which is impacting all beaches along the Adelaide coastline. This means Adelaide beaches and dunes don't have sufficient time to regenerate between storms

- **Shoreline retreat**

From DEA data of Geoscience Australia all of Adelaide's metropolitan beaches have experienced shoreline retreat in the last two years. This has major implications for the installation of any hard infrastructure either on the beach or close to the shoreline.

With sea level rise and more frequent storms impacting all SA coasts there will demands on finite budget resources for remediation and ensuring security of those coastlines with associated infrastructure impacted.

- **Higher tide levels**

  Between May and November 2022, the Outer Harbour tide gauge recorded 20 events with a peak water level above or higher than 3.0m CD (1.55 m AHD) this water level is approximately equivalent to 1:1 annual occurrence event. Based on DEW observations, the cumulative impact of 20 such events last year appeared to result in similar erosion to one or two severe events. (DHI report 2023)

What we know about the community's views on sand management options and approaches including pipelines and trucking and what we know about minimising disruption for all communities.

- **The ABMR survey** provided information regarding the community's views
  The top responses to the survey were that sand management vehicles such as trucks, heavy equipment and permanent and or temporary plant equipment on beaches were the most disruptive to communities due to the impacts on beach amenities, noises and smells from heavy machinery, risks to safety and risk to dunes and beach profile.
- **Trucks, heavy machinery and loss of beach amenity** are a major disruption to communities
- Sand collection and processing activities have a major impact on tourism, beach visitors and associated businesses.
  Adelaide beaches have over 41,000,000 visitors per year. Beaches impacted by loss of beach amenities due to trucks, heavy machinery, and plant equipment both temporary in nature or permanent represents a significant loss of income for associated businesses.
- **The cultural and historical landscape of the Kaurna people**
  The 14 kilometres of the northern area beaches is a significant cultural landscape for the Kaurna people who are the traditional owners of the Adelaide plains. Although there isn't any Native land titles in the project area, it is still a significant part of cultural landscape which is renowned for restoring cultural memory. Respect for the Kaurna community's connection to this cultural landscape should be considered and not disrupted. A 14 km pipeline installed both on beaches and in dunes runs through the Kaurna People's cultural landscape.

What we know about avoiding environmental harm

- Addition of Nano and microplastic particles to the environment
  EPA definition of Environmental Harm
  Section 5 of the EPAct sets out the definition of environmental harm. Environmental harm under the EPAct relates to harm caused by pollution and the impact on health. (See section 5 of the EPAct attached).
  Pollution is defined in the EPA and the definition includes nano plastics and micro plastics on the beaches and in the ocean. (See attached section 3 of the EPAct.)
  The potential for nano plastics and micro plastics in the gulf and on the beaches from the pipeline options would be covered under the definition. Mathematical calculations of the 50% abrasion of the 14 km long, 35mm thick HDPE pipeline estimates there would be 126 cubic metres or 121 tonnes of plastic in the form of billions of nano or microplastic added to our marine environment. *K Duis 2016 Microplastics in the aquatics and terrestrial environments '..the release of plastics into the environment should be reduced in a broad and global effort…t"*
- **Natural and built environmental harm**
  As the 14 km pipeline will be installed into beaches, dunes, footpaths, under jetties, in roads and under the Torrens outlet there is possible and significant risk to both the natural and built environment. The Semaphore to West Beach Sand Pumping Pipeline System Development Application cites risks to a number of regulated and significant trees in the project area. It also cites risk to heritage structures such as jetties due to required earthworks during the pipeline installation. The dune area between Terminus Street, Grange and the Grange Jetty will be severely impacted by both the installation of a pumping system and the pipeline.
- **Unique biodiversity** – The Gulf of St Vincent and its associated beaches contain a unique and a wide biodiversity. The Development Application documents for the Semaphore to West Beach Sand Pumping Pipeline system outlines many unique species of flora and fauna (many of vulnerable or threatened status) that will be impacted by the construction, installation and operation of the pipeline.

- **Regulations on dredging** – Although there are concerns about the impacts of dredging on the marine environment ‘‘Investigations of the borrow area would be required to assess the resource and its suitability for beach nourishment. This would involve bathymetric and geophysical surveys, shallow (vibro-coring) and sediment sampling and analysis. Should suitability be confirmed then concept dredge and placement designs as well as environmental approvals, licences could be progressed. Environmental impacts would require assessment and likely to require dredge plume modelling, ecological (seagrass) surveys and baseline monitoring (water quality and possibly noise). A range of environmental management activities, including turbidity monitoring and pre- and post-dredging seagrass surveys, will be required during the works” The EPA established new Dredge Guidelines in 2020. The Application of the Dredge Guideline assist dredge proponents and licensees in meeting their general environmental duty under section 25 of the Environment Protection Act by demonstrating that all reasonable and practicable measures have been undertaken to minimise the potential for environmental harm. With the provisos of these regulations overseeing dredging activities and the requirements of modelling, surveys and baseline monitoring in addition to a preliminary environmental assessment, dredging can be done effectively with limited damage. Dredging is one of the most studied and stringently enforced methods.

What we know about maximising sand staying on beaches and what we know from international examples of sand management

Elements that were considered primary by Bitan & Zviely (2020) in their study of the durability of major renourishment beach projects in Spain, Italy and France were the grain size of the imported sand, the overall volume of sand involved, timing of nourishment and sand placement

- **Grain size**
  To maximise sand staying on beaches the grain size needs to be 1.5-2.0 times the grain size of the sand where the beach is being nourished. High carbonate sand tends to be brittle and break readily into smaller grain size
- **Correct placement**
  The sand needs to be placed off shore, in the surf zone and not on the beach face where it will steepen the beach face and cause elevated erosion. Off shore placement tends to build a healthier profile of the beach being nourished which results in sand remaining on the beach for longer.
- **Right amount and time**
  There needs to be a mass amount of sand delivered in one or two nourishment events. Small amounts fed on to a beach does not work effectively.
  The timing of the nourishment should be when nature can best bring the sand towards the beach.

Cost

Climate change impacts and cost

The predictions in the recent IPCC report are for 50 to 80 metres of beach recession by 2050. The DEA data by Geoscience Australia data shows the recession of shorelines in 2022. As we see further impacts of climate change many South Australian coastline will need securing for the future. There will be competing priorities for finite tax-payer funded in securing of coastlines.

Buffering the coastline with additional sand resource is the only effective method in making our beaches more resilient to sea level rise and increased frequency of storms. Few of the options offered in the review will provide the volume of sand required to place the Adelaide coastline back into equilibrium. Recycling of sand through a pipeline delivering unsuitable grain-sized sand onto a beach face will not address this problem and will result in an unsustainable and ineffective use of finite tax-payer dollars causing more harm than good and a need for future spend.

Instead, the less expensive, more effective, less disruptive and less environmentally harmful options of dredging and delivery via barge to the near shore could be adapted to the changing needs of Adelaide’s beach management and could be implemented expediently.

One of the most critical elements in decision making for governments is balancing finite resources for competing priorities. This was not included in the review, nor was a cost benefit analysis undertaken which is also a critical element of responsible and considered decision making. Although the cost was not a specified factor of the review the various solutions were costed. It is a principle of responsible governments to ensure the best value proposition for the use of public monies.

Time in implementation (Lead Time) of options

As some of Adelaide beaches are in urgent need of intervention, the time period to achieve full operation (lead time) of any option is paramount. The impact on Northern area beaches of numerous high tides and more frequent storms will see delays in the installation of the pipeline on the beach faces increasing the lead time of this option. The requirement of installation earthworks to a number of areas of infrastructure along the pipeline route, including the installation of the pipeline into the Esplanade from Henley Square to the Torrens Outlet and the water pipeline under Military Road will require more time to implement in comparison to accessing small Trailer Suction Hopper Dredges from the east coast of Australia which are readily available. All options, including the new extended pipeline will require further environmental assessments (including social and economic impacts) as required by legislation.

In summary, attached to this submission is a criteria-based assessment of the 7 proposed options for managing Adelaide's beaches, using the goals of the review as criteria. Each option has been given a score out of 5 for each of the goals of minimising disruption for all communities, avoiding environmental harm and maximising sand staying on beaches. Each criterium has been assessed against how well each option meets the metrics of achieving the goals.

Few options offered in the review actually will provide the volume of sand required to place the Adelaide coastline back into equilibrium or greater which is an absolute prerequisite to making our beaches more resilient to sea level rise and increased frequency of storms. Recycling of sand onto the beach face does nothing to address this but merely transfers the erosion hotspot to the donor area.

The pipeline options 2.1 -Score-2/15, 2.2 - Score- 2/15 and 2.3- Score -2/15 a fail the three goals of minimising disruption for all communities, maximising the sand staying on the beach and avoiding environmental harm. The pipeline options are the most costly, least effective at providing a successful outcome for all 3 goals and are unsustainable.

The Carting option 3- Score- 4/15 continues to not meet the needs of Adelaide's beaches while causing disruption to communities at both the donor and recipient beaches while putting protective dunes at risk of donor beaches.

The Dredging Options 1.1 – Score 13/15, 1.2. – Score 13/15 & 1.3 – Score 11/15 met all of the review's goals being the least disruptive and maximising sand staying on beaches. They were also the least expensive, sustainable and had the added flexibility to be able to adapt to the changing needs of Adelaide's coast lines. Consequently the Dredging Options are the options that should be progressed to the next level of the Review.

Robyn Ravalico
[redacted]

Port Adelaide Resident's Environment Protection Group

e: [redacted]

Response to Coastal Management Review's second public consultation: Options shortlist

PAREPG's first submission in June 2023

- drew attention to previous work (Kasper Hauberg Kærgaard 2018) which showed all beaches north of the Torrens have been eroding over the last decade, and
- Used DEW survey data to show a trend of sand loss from Semaphore Park to Taperoo beaches over a similar period

Geoscience Australia's recent September 2023 release confirms that although coastlines have moved seaward since 1988, that trend has been reversing in recent years.

The example below illustrates this trend. Coastlines to the north reach a seaward maximum some what later but all are currently moving inland

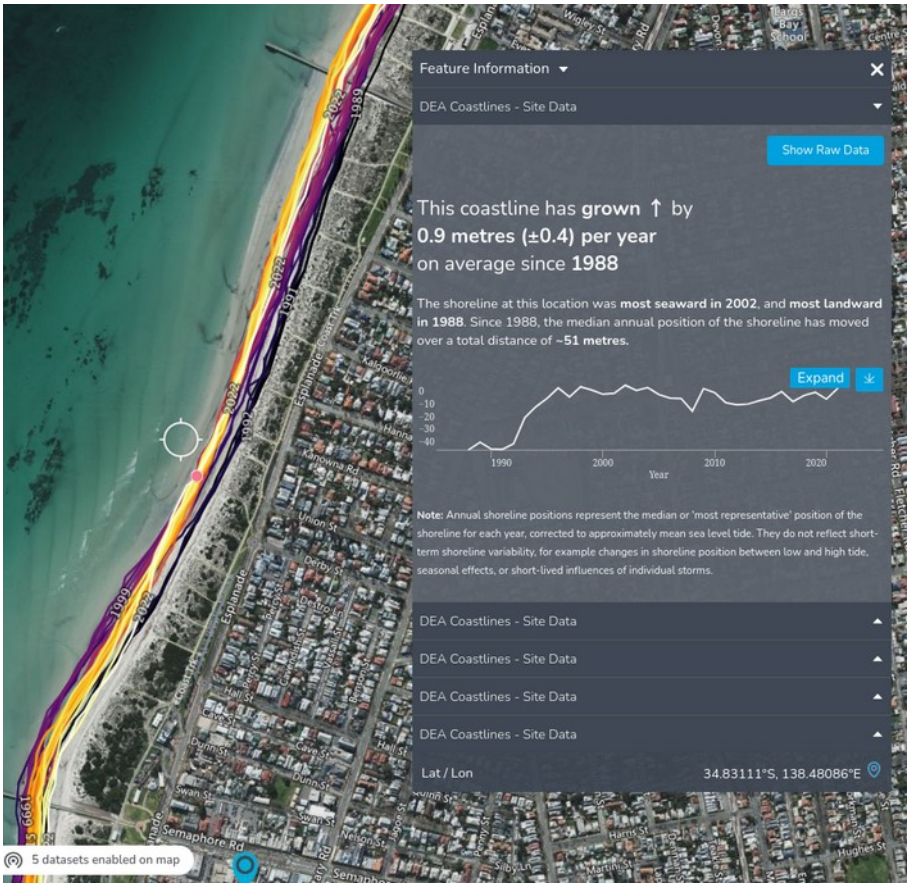


Figure 1: Geoscience Australia's coastline model at Kanowna Rd shows the coastline moving seawards overall since 1988 but moving landwards since 2002 ("Digital Earth Australia Map" 2023)

The weight of evidence from these sources show that while removing sand from northern beaches to supply those to the south may have been tenable a decade ago it is no longer sustainable, particularly in the face of the effects of climate change and local subsidence in the Port Adelaide region(Belperio 1993)

The low angle beaches north of Largs Bay are particularly vulnerable as an increase in sea level corresponds to a proportionately larger landward incursion. Moreover the dune area is noticeably flat, perhaps due to sea grass accumulation restricting the landward transport of sand by wind.

If not the northern beaches where will sand be sourced

It has now become obvious that reducing the problems at West Beach and supplying sand to an eroding coastline will require importing significant amounts of sand if coastal retreat is not an option.

A number of options have been suggested. The Section Banks " and surrounds", North Haven, Port Stanvac, and terrestrial sources have been identified in much earlier studies and rejected.

"Section Banks and surrounds"

> "It is widely considered that the Section Bank is a natural extension of the LeFevre Peninsula. The Section Bank was separated from the LeFevre Peninsula, and hence the littoral system of the metropolitan coastline, by the construction of the Outer Harbor breakwaters and shipping channel in the early part of the nineteenth century" (Davis, Joseph 2005)

The largest deposit identified is at the Section banks. Figures 1 and 2 below show the area, and assessed conservation values



Figure 2: Section Banks area, with targeted extraction location delineated in orange

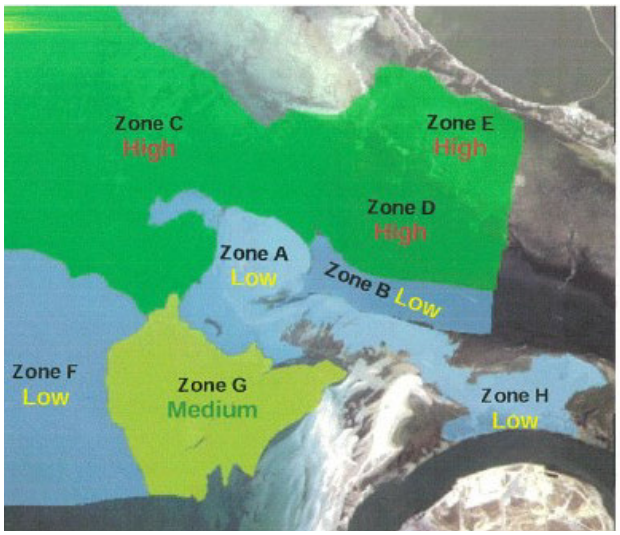


Figure 3: Assessed conservation value of areas in the Section banks(Anthony Cheshire et al. 2002)

Considerable investigation into mining the Section bank area occurred around the start of the century. Sand quality was assessed and a deposit with acceptable quality delineated.

An environmental assessment identified areas of conservation significance and potential hydrodynamic problems associated with mining. High conservation values included areas of seagrass with long (~100 years) regeneration times, erosion of mudflats in front of mangroves used as feeding resource for migratory shorebirds, and damage to mangroves protecting the shoreline.(Anthony Cheshire et al. 2002). PAREPG notes that since then considerable investment has occurred in reducing the nutrient levels from the Bolivar sewage treatment plant which was the major agent of environmental degradation in the area.

The prospect area was identified as of relatively low conservation value and suitable sand quality lies on the north western edge. However, removing material from the bank increases the potential for the collapse, exposing high conservation areas to destruction by increased wave action.

A wave action modelling(Davis, Joseph 2005) study excluded direct mining from the north western side due to the potential of direct harm to sea grasses, but rather considered an approach from the south east, where reduced depth would limit access to a small dredge. Three scenarios were considered. - The removal of 1m m^3 of fine unsuitable sand would be necessary to access firstly 1m m^3 and then a further 0.5m m^3 of target sand. The conclusions were:

> *For all dredging scenarios simulated there was a large localised increase of the orbital velocity on the crest of the sandbar This increase in velocity has the potential to further reduce the height of the sandbar by increasing the erosion potential along the crest of the sandbar*

PAREPG's understanding is that the current proposal is for a large trailing suction hopper dredge to be used, which implies access from the previously excluded deeper waters of the north western side, to transport 2.5m^3 of material to West Beach.

Such a proposal is squarely at odds with the Coastal Review's objectives to "avoid environmental harm"

North Haven



Figure 4: Dredge target area (from Options Technical document) overlain on Google Earth image(2012)

The target area is immediately south of the Outer Harbor channel. While interpretation of Figure 4 above is not straightforward, it does appear a large proportion includes areas that are not bare sand, probably sea grass or *Pinna bicolor* beds. *Pinna bicolor* are often found on the beach after storms in the area,

sometimes associated with *Ostrea angasi* the native flat oyster(“Reefs – Australian Shellfish Restoration” n.d.). *Ostrea angasi* are one of the organisms associated with the shellfish reef harvested to extinction after colonisation in South Australia.(Alleway and Connell 2015)

The area has been affected by discharge from the much maligned Port estuary, but it should be noted that the high nutrient levels from the Penrice Soda ash plant ceased 20 years ago in June 2013.

Ostrea angasi have been grown successfully in the Port estuary (“Projects – Information – Estuary Care Foundation SA” n.d.).

Indeed it should not be assumed that:

- recovery is not occurring in this area and
- will not continue to occur and
- that it is not worthy of preservation.

Port Stanvac

We note that DEW proposed using sand from Port Stanvac during public consultation on the West Beach problem in 2021, but the deposit was reported to be unsuitable, forcing a change of strategy to use commercially sourced sand which is still used today.

Consequently PAREPG are unsure as to why an action previously found to be unsuitable now forms a credible option.

Alternative sand sources

The problems identified above with using sources above make their use high risk. Not only risk in terms of eventual failure, but risks in the delay of implementing a sustainable solution. PAREPG are very much aware of the time spent in following what turned out to be false hopes in pursuing the Stanvac deposit and it’s essential that experience should not be repeated.

Alternative sources exist. - marine sources further south around Cape Jervis and commercial deposits on the Yorke peninsula and large deposits on the Fleurieu Peninsula:

> *The Mineral Resources group of PIRSA has identified large potential resources of Permian sand in the Mount Compass area, some of which have been estimated from drill hole intersections to be several million cubic metres in volume, or enough for hundreds of years’ supply at current beach replenishment rates The sand in selected deposits is slightly coarser than existing beach sand and light brown to white in colour, with a variable but generally low fines content These characteristics make it desirable beach replenishment sand (Department for Environment and Heritage 2005)*

Terrestrial, unlike marine deposits have an advantage in that mining regulatory processes are in place and any infringements are readily visible and potentially enforceable.

Sand dredged from the Murray mouth is currently a problem, in that once dredged and dumped onshore it drifts back into the mouth making the clearing operation perennial. Sourcing this sand for metropolitan beaches solves two problems and appears to be an attractive and sustainable option

Pipeline options

PAREPG do not support Option 2.1, mining the northern beaches and transporting sand south by pipeline because

- as outlined in the beginniong of this response, mining sand from demonstrably eroding beaches is not sustainable,
- the pipeline is now demonstrably the most expensive option

- the continual loss of beach amenity by beach users
- the obvious effects of continual removing the contents of the intertidal ecosystem.

Option 2.2, installing an array of jet pumps on the Semaphore and Largs Bay jetties is not supported as:

- the jetties are heritage listed, constructed primarily of ageing timber, which militates against supporting significant industrial loads and vibration.
- deepening the areas close to the jetties so are likely to increase stress on relatively fragile jetty structures.
- the loss of a well used public facility for significant portion of the year.
- reliance on an expensive pipeline structure

Option 2.3, feeding a pipeline by a mobile dredge between the Semaphore South and the Largs Bay jetty is also not supported:

- The choices are to operate the mobile dredge either:
  - in sea grass beds, thus destroying the beds and increasing coastal erosion
  - in shore of the sea grass, reducing the volume of sand in the nearshore profiles, decreasing the sand available to nourish the shoreline, and ultimately increase erosion of a section of the coast which is already eroding and vulnerable to the effects of sea level rise.
- Again the use of a pipeline puts this in the most expensive bracket

Tony Bazeley
Secretary

15/10/2023

References:

Alleway, Heidi K., and Sean D. Connell. 2015. "Loss of an Ecological Baseline through the Eradication of Oyster Reefs from Coastal Ecosystems and Human Memory: Loss of Oyster Reefs to History." Conservation Biology 29 (3): 795–804. https://doi.org/10.1111/cobi.12452.

Anthony Cheshire, Sue Murray-Jones, Leonie Scriven, Ron Sandercock, and David Miller. 2002. "The Section Bank: Ecological Communities and Strategies for the Minimization of Dredging Impacts." West Beach South Australia: SARDI Aquatic Sciences.

Belperio, A. P. 1993. "Land Subsidence and Sea Level Rise in the Port Adelaide Estuary: Implications for Monitoring the Greenhouse Effect." Australian Journal of Earth Sciences 40 (4): 359–68. https://doi.org/10.1080/08120099308728087.

Davis, Joseph. 2005. "The Section Bank: Wave Processes Study." Adelaide, South Australia: Coast Protection Board.

Department for Environment and Heritage. 2005. "Adelaide's Living Beaches A Strategy for 2005 – 2025 :Technical Report." https://www.environment.sa.gov.au/files/sharedassets/public/coasts/alb_technical_report.pdf.

"Digital Earth Australia Map." 2023. September 2023. https://maps.dea.ga.gov.au/story/DEACoastlines.

Kasper Hauberg Kærgaard. 2018. "West Beach Coastal Processes Modelling Assessment of Coastal Management Options." DHI Water & Environment Pty Ltd. https://www.environment.sa.gov.au/files/sharedassets/public/coasts/west-beach-coastal-processes-modelling-rep.pdf.

“Projects – Information – Estuary Care Foundation SA.” n.d. Accessed October 15, 2023. https://www.estuary.org.au/projects-info/.
“Reefs – Australian Shellfish Restoration.” n.d. Accessed October 15, 2023. https://shellfishrestoration.org.au/shellfish-reefs/.

From: deansyorath
To: mail
Subject: re consultation on Adelaide Beach Management Review Options Shortlist CONFIDENTIAL
Date: Sunday, 15 October 2023 4:29:31 PM
Attachments: Coasts and Ports 2011 paper.pdf

To URPS Re: consultation on Adelaide Beach Management Review Options Shortlist

I am providing this information for the attention of the Adelaide Beach Management Review Independent Advisory Panel with some technical information regarding the Options currently under public consultation.

I am a retired professional in the Coastal Engineering and Project Management disciplines and have worked on managing Adelaide's beaches for close to 20 years. I do not wish to have my contact details made public through the consultation process however I advise that there are significant technical aspects that do not appear to have been sufficiently considered in the preparation of the Options shortlist that has been released for public consultation and I wish to bring these to the attention of the Advisory Panel. I ask that this information be conveyed to the Panel and not publicly released, and request that privacy of my personal details be respected.

My informed view is that many of the Options presented are technically infeasible or environmentally undesirable due to a number of factors, the simplest and most pressing of these to formulating workable Options include:

1. The importance of sand grain size and particle density of any sand that is to be used for beach replenishment to ensure effective management of erosion risks as well as operational efficacy of slurry systems.
2. The necessity of sourcing and moving sand to minimise the release of fine sand, mineral and organic particles into the nearshore waters, creating turbidity.
3. The lack of confirmed offshore sand resources with sand suitable for beach replenishment purposes.
4. The unsuitability of jet-pumps (and similar point-location methods) for sand collection along Adelaide's coast due to local beach morphology.
5. The implications of Climate Change, both in regard to rises in sea level and changes in climate, including weather trends (changes in ambient wind and hence wave climates) and extremes (storminess and frequency).

The many technical reports and strategy reviews of the Coast Protection Board contain more information about these factors and other considerations, with specific focus on the management of the Adelaide coastline, within the context of management of the coastline around the State, and with reference to Australian and International best practice. Advice needs to be sought from the Board and professional staff who advise the Board, particularly with regard to relevant technical matters.

These notes outline where I consider significantly more attention is required to prepare genuinely deliverable concept-level Options for mid-term beach management in Adelaide;

1. Sand-grain size and particle density

Sand grain size and particle density are very important characteristics of sand in relation to many physical processes and hence selection and design of beach management approaches. Some aspects that are particularly relevant to Adelaide beaches include;

a. The rate at which sand is moved by waves (including long-shore drift of sand, and quantities of sand eroded during storm events) is greatly dependent on grain size and density: rates being far greater for small diameter and density grains. Rates of various processes being proportionate to sand diameter by a power of between 3 and 5.
b. The morphology of beaches, in particular the tendency of waves over time, to separate

and to deposit finer and lighter sand particles in the seaward part of the beach, and coarser and more dense particles in the upper part of the beach.

c. That the slope of beaches consisting of finer grained and lighter sand particles is much flatter than that of beaches consisting of coarser and more dense particles under the same wave and other environmental conditions.
d. The implication of the above three processes is that much larger quantities of finer and lighter sands are needed to replenish a beach effectively than if sand with characteristics similar to (or more coarse than) the existing sand at the top of a beach (above high water mark) is used to replenish it. Effective beach replenishment requires both a sand volume to obtain a beach that will provide risk management of erosion impacts (a buffer), and the annual beach replenishment rates required to maintain risk reduction buffers and benefits over time.
e. The nature of longshore drift in Adelaide has resulted in deposition of sand in the northern nearshore areas being significantly finer than the sand on the more southern beaches, including in the West Beach area. The sand in the northern areas has also been contributed to by biological processes and a large fraction of the sand deposits are carbonate materials with a lower density than silica sands. This implies a further unsuitability of this sand for beach replenishment purposes, due to the three processes listed above.
f. Management approaches that can achieve the retention (eg through collection and placement further south) of coarser sand in the southern and central parts of the coast through replenishment will be the most effective at providing risk management of erosion impacts. Such approaches would also reduce the loss of sand from the beaches into deeper water, potentially smothering seagrass meadows (as would occur if fine sand was used in larger quantities on beaches such as at West Beach).

Any pumped system will need to examine the range of sand characteristics that it needs to be designed for and I have attached a technical paper that summarises work undertaken to determine this for the existing pumping of sand on the southern part of the Adelaide metropolitan coastline. The peer-reviewed paper was presented at the 20th Australasian Coastal and Ocean Engineering Conference 2011. Page 727:
https://www.proceedings.com/content/016/016278webtoc.pdf

2. Turbidity Management

Attention is required to minimising the turbidity levels in the nearshore waters as a result of any sand movement technique proposed. This is necessary to protect the remaining and the regrowing seagrass meadows in the Adelaide coastal area. Progress has been made in restoring the health and extent of these seagrass meadows which are effective, where healthy, in reducing the erosion and deepening of the seabed. Further erosion and deepening of the seabed that would be likely to occur if seagrass is lost, would lead to waves that reach the beaches having higher energy (than where wave energy has been dissipated by healthy seagrass meadows) and a consequent increase in the rate of sand movement along and erosion of the beaches. Dredging of sand results in the suspension of fine particles which cause turbidity, one of the principal pressures on seagrass meadow health. To state as the Review Options reports do, that dredging is *'subject to further investigations and approvals'* is disingenuous where approval is most unlikely to be received due to the unavoidably high levels of turbidity that result from dredging offshore sand in particular and where sand (and fine particles) are discharged close to the vulnerable seagrass meadows. In addition to these bio-physical effects are potential impacts on marine ecology and I expect that others with more relevant expertise in this matter than I, will provide more specific details regarding this significant aspect. I recommend that these

comments and advice be given full regard.

3. Lack of Confirmed Offshore Sand Resources.

Extensive studies of sand resources offshore of Adelaide have been undertaken by the Coast Protection Board over many years – none has found viable reserves of suitable sand (grain size distribution, cleanliness from impurities and deposit depths and sufficient thicknesses for extraction with current technologies) beyond the sand quantities that have already been used for beach replenishment. Fine and carbonite rich sand in the area offshore from North Haven and Largs Bay in particular are unsuitable, as detailed in 1. above. Again the phrase *'subject to further investigations and approvals'* is disingenuous as such investigations are unlikely to identify suitable sand resources.

4. Jet-Pump Unsuitability

The slurry pumping technologies referred to in the Review documents are described at a conceptual level only and are based on infrastructure used interstate and overseas in greatly different coastal settings. These systems rely on thick deposits of sand in the littoral beach being constantly redeposited by much larger and generally more seasonally-consistent wave energy than occurs along the Adelaide coastline. The Adelaide coast's sand movement occurs variably on a seasonal and inter-annual basis. The tidal range in Adelaide is large in comparison to wave heights and as a consequence sand movement along the Adelaide beaches occurs across a wide range of elevations (from the sand-bar(s), across the beach, to the foredunes). This results in generally wide flat beaches with thin layers of sand deposition, often in a series of sandbars, completely unsuited to sand collection by point-source methods such as jet-pumps.

Considerable research and investment has been made over the years to seek alternative technically-feasible methods of sand collection suited to the Adelaide situations. Sand-scrapers based on landplanes have been found to be the most suitable method of removing the thin layers of sand required to be moved as a result of the widespread nature of sand deposition on our beaches. Furthermore, use of sand-scrapers/landplanes can be managed, with care, to avoid the worst odour and turbidity problems associated with removal of deeper sand layers within the beach where entrained seagrass detritus has decomposed.

5. Climate Change and design conditions.

A discussion is necessary of the likely impacts on management of the Adelaide coast of Climate Change, in particular assessments need to be made of likely increases in the general rates of long-shore drift of sand (chronic impacts) and the increasing frequency of high water-level storm-surge conditions which erode coastal dunes and upper beaches (acute impacts). This discussion needs to also present the base-line level of current risk for which designs are to be prepared to ameliorate. For example with reference to the capacity of designs to withstand various storm conditions such as the 1981 storm events.

It is disappointing and misleading at best, when 'Options' that are technically infeasible are presented to the public as potential solutions to the difficult and costly realities of managing our eroding coastline and the associated risks of erosion and amenity impacts on its high value cultural, heritage, recreational, built and environmental assets.

Jennifer Deans, B.E. (Civil)

Pumped Beach Replenishment in Adelaide: Selecting the Design Sand

Deans J.A.[1], Tucker R.T.[2], and Thomas, A.D.[3]
[1] Department of Environment and Natural Resources, South Australia; Jennifer.Deans@sa.gov.au
[2] Department of Environment and Natural Resources, South Australia; Robert.Tucker@sa.gov.au
[3] Consulting Engineer; allan@allanthomas.com.au

Abstract
Variations in the grain sizes of beach sand along the Adelaide metropolitan coast have been investigated in relation to assessing likely pumping efficiency and practicality for a proposed change in beach replenishment methods from sand carting to sand pumping. Pumping rates, achievable slurry concentrations and pump and pipeline design parameters are examined for the range of sands occurring in the mid-coast sand accumulation areas of the Adelaide coast. Determination of the 'design sand' is a critical aspect of the sand pumping infrastructure proposed, as it influences pipe wear and pump size with pumps that could be operating at peak capacity, possibly requiring two pumps per station. The paper includes results from recent and historic sand sampling and analysis work. The influence of nearly 40 years of beach replenishment and concurrent sediment transport processes on sand characteristics and distribution is discussed with some projections made of likely future sand characteristics. The November 2010 sand pumping trials are outlined, with results presented for dredged pumping of 'fine' and 'coarse' sands at a range of slurry concentrations in a 285 mm ID test pipe of 400 m length.

Keywords: beach replenishment, beach nourishment, slurry pumping, sediment grain size

1. Introduction

The paper outlines the history to the selection of a 'design sand' in the development of a new sand slurry pumping system for beach replenishment of Adelaide's beaches, and discusses the investigations and experiments conducted to determine the design sand for the system and the influence of the design sand on the design and its sensitivity to variations in sand characteristics.

2. Background

Adelaide's urban coastline of approximately 28 km has been replenished for nearly 40 years to counter recession of its southern to mid-coast sections. Initial replenishment rates were low, with trucks carting sand from accumulation areas, southward to eroding areas, ie 'backpassing' sand within the greater littoral cell. In the 1980s carting within the littoral cell was augmented with sand dredged from offshore sources and small quantities from onshore quarries. In the late 1990s two small harbours built within the littoral cell, required sand to be bypassed to maintain littoral drift along the coast, continuing a whole of littoral cell backpassing approach to managing the coast.

In 2005, with the adoption of the State Government's Adelaide's Living Beaches (ALB) strategy [1], the metropolitan coastline was philosophically segmented into seven sand management cells. These cells were set by the littoral boundaries of the new harbours and other features that influenced littoral drift. The new strategy retained beach replenishment as the means of coastal protection and management but aimed to integrate sand management at the harbours into beach management by recycling (backpassing) sand within each sand management cell rather than along the greater littoral cell as a whole. The advantage of this approach is that expense and energy to collect and handle sand would be directed to backpassing of sand from where it accumulates and keeping it further south in the system. The Adelaide beaches are characterised by limited deposits of sand suitable for beach replenishment and the loss of beach compatible sand to the northern beaches where large quantities of finer sand also accumulate. The recycling approach will conserve beach compatible sand and reduce the costs of maintenance dredging of the harbours.

The approach of the ALB strategy is that sand recycled within the littoral cells would be collected by beach-based sand collection units and dredges and transported by slurry pumping to fixed discharge points, which had been selected to include past, current and future erosion hotspots.

The sand pumping scheme and its operation is to be provided under a 20 year Design Construct Operate and Maintain (DCOM) contract. The Sand Transfer Infrastructure (STI) project was originally to pump sand within four of the sand management cells, with the ability to pump sand southward between cells. Its entire length was to be 22 km, with four main pump stations, seven booster pump stations separated by approximately 2 km, but up to 2.8 km intervals. The locations of main and booster pump stations were restricted by the densely urban nature of the foreshore, with existing parks being favoured to limit visual impacts to residents and businesses. The system would have the capacity to pump 75,000 m^3 of sand in each cell per annum, within operating hours restricted to day working hours from 7am to

7pm and with constraints on days of work, including public holidays and hot weather.

Normal slurry pumping concentrations sought during operation were 35% by weight. Sand to be pumped was described as an average median diameter (d_{50}) of 0.22 mm but sand of a 'maximum d_{50} grain size of 0.5 mm' also needed to be pumped. The system needed to be able to operate within the local environment, including frequent, although unpredictable high levels of seagrass wrack, local wave and tide climate and the necessity to meet bathing water quality standards in the marine water nearby slurry discharge points.

3. Concept Design for the project

Initial scoping for the project included a Registration of Interest (RoI) for technical advice on sand pumping, in 2006. Assisted in-house concept development was followed by the appointment of professional services consultants (project management, technical services and cost managers), in 2008, for preparation of a Concept Design. Following a call, in late 2008, for Expressions of Interest (EoI) from the market in undertaking an anticipated DCOM contract; short-listed consortia were invited to tender for the DCOM contract in September 2009, with tenders closing in December 2009.

During tender assessment and negotiation it was identified that aspects of the Principal's Project Requirements (PPR) required critical review and that the tenderers could not achieve the full project within the budget available. The independent consultant, Dr Allan Thomas was appointed to assist with review of slurry pumping and hydraulics design aspects of the tender assessment.

The STI project was adjusted in September 2010 to include slurry pipelines in only the two cells that had the greatest benefits in cost effectiveness of slurry pumping over sand carting, and greatest recreational benefits through reduced disruption to use of the beaches. The shorter scheme has a combined pipeline length of 9 km, two main pump stations and three booster pump stations. Sand characteristics and slurry densities required to be pumped were adjusted including additional information about grain size distribution from a November 2009 sample program. A revised PPR was released in October 2010 to the preferred tenderer inviting a revised tender. A revised tender was received in February 2011, with tender negotiation continuing during writing of this paper.

Development of the concept design focussed on the necessity to manage dead seagrass material entrained within and accumulated on and within the sand deposits. Evaluation of the initial tenders and preliminary design information identified the critical nature of sand grain distribution as well as d_{50} grain size in the hydraulic design for the STI.

Results of some sand samples, notably at low water mark (LWM) at one of the source beaches for sand collection, showed some much larger grain size sand than is generally expected on Adelaide's beaches. Dr Allan Thomas was engaged to assist in the tender evaluation for the STI and also to understand the influence of grain size distribution on pumping system design and operation and to identify how this matter could be better represented to improve certainty for both principal and tenderer.

4. Characteristics of Adelaide's beach sand

4.1 Historic sand observations

Sand characteristics for Adelaide beaches were documented in 1970 from samples taken in 1966. The sand is over 90% silica sand on all but the northernmost beaches. The d_{50} of the majority of samples was between 0.2 and 0.3 mm for locations at LWM, HWM and above HWM, along the coast. The highest d_{50} was 0.5 mm at mid-coast and southern locations, with d_{50}s between 0.17 and 0.2 mm on the northern accreting beaches. These are detailed in the Department of Environment and Natural Resources Technical Report 2010/2, [2].

Since that time, beach replenishment including the 'backpassing' of over 1 million cubic metres of sand and a further approximately 1 million cubic metres of dredged sand from the offshore Port Stanvac source as well as small quantities from other sources have been added to the southern beaches. The Port Stanvac sand had distinctly bimodal characteristics, with about 20% of grains being between 0.425 and 1.18 mm sieves and over 40% of grains finer than 0.212 mm sieve. When hydraulically placed on the beach it was observed that waves quickly sorted the finer sand seaward and further along the beach, transporting it along the sand bar. The results of limited post-replenishment beach sampling reflect this observation, as shown in Figure 1, where the 1982 sample of beach sand at Brighton is used as a benchmark.

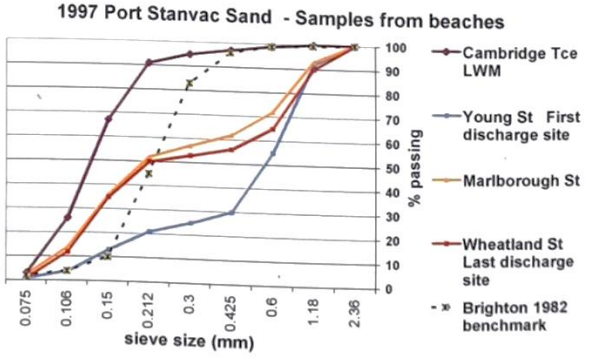


Figure 1: Note the finer grading of the sand at the low water mark (LWM) at the more northerly Cambridge Tce location, compared with the 1982 benchmark sand from Brighton and the coarser grading of the wave-washed sand from the first placed Young Street location (in blue).

4.2 Present sand

A sand sampling program in 2002 was part of investigations for the ALB strategy; samples obtained at LWM and HWM indicated similar d_{50}s to the 1966 sample results, with the exception of two samples toward the southern beaches, with d_{50}s of 0.7 mm and 0.58 mm at HWM and LWM. The standard sample sieving includes shell; then samples are acid washed, % weight reduction is noted – usually of the order of 5% to 10%, though this data is not further referred to in this paper.

Further sampling in November 2009 was more intensive but focussed on the sand accumulation areas for the STI project. Samples in the southernmost sand management cell were the coarsest with some particularly coarse sand at LWM as shown in Figure 2.

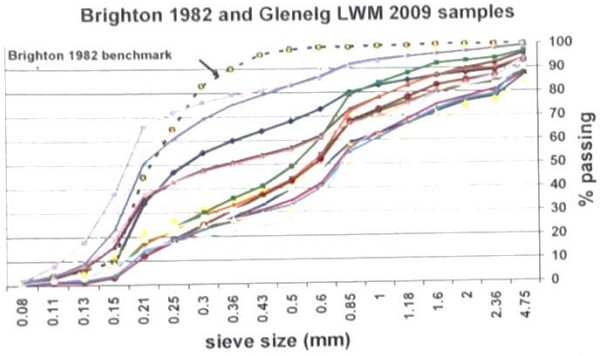


Figure 2: Samples from LWM at the sand accumulation beach; note that many of the samples have d_{50}s greater than 0.5mm and a significant portion of sand with grain size greater than 1mm.

In light of the unexpectedly coarse sand at the planned STI source site for the main southern sand management cell, and an increased understanding of the significance of the coarse sand in hydraulic design of the STI, additional sampling along the beaches was undertaken in 2010. The sampling program aimed to 'look into the future' by sampling sand that will drift into the accumulation area and to investigate whether the very high d_{50} sands sampled in 2009 were representative of the sand that was likely to accumulate in the future. Figure 3 shows the range of sands found within the southern sand management cell sampled at MWM and HWM in November 2010, compared with the benchmark 1982 sample.

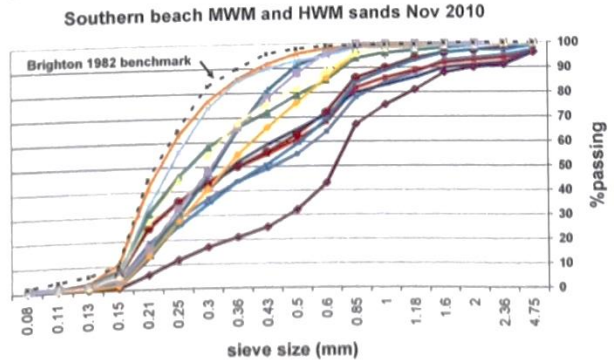


Figure 3: Sand samples throughout the southern sand management cell – note that they are generally less coarse than the 2009 samples in Figure 2.

Tide conditions at the time of sampling limited the seaward extent of samples obtained and LWM samples could not be obtained.

Further samples at the source sites for the STI project were taken and analysed in less detail with a wet-sieving method but with a focus on the proportions of the sample passing 1 mm and 0.5 mm sieves as this range was considered to be useful in indicating the suitability of the sand for slurry pumping efficiently. It was found that on average, 74% of the sand would pass the 0.5 mm sieve. It is noted that checking of the method for four samples using conventional analysis indicates that the wet sieve test method underestimates these proportions by approximately 8%.

4.3 Characteristics of sand in the future

With a design period of 25 years, any changes in the distribution of grain size of accumulating sand over time could affect the system efficiency. As well as the characteristics of the sand already within the littoral system (both 'native' and fill sands) the factors influencing future sand characteristics are twofold; the characteristics of sand added to the system through future replenishment of beaches from outside sources, and relative differences in sand movement for different grain sizes due to littoral drift or other physical processes. The latter would include sorting of sand if it is collected by the STI selectively on grain size, or different relative rates of littoral drift of the beach sands.

It is conjectured that sand moving from the southernmost sand management cells to beaches to the north has been filtered by the built obstructions of harbours, possibly contributed to by the practice of sand bypassing at the harbours (predominantly by dredge) since the late 1990s. This could have increased the d_{50} in the southern onshore accumulation areas resulting in the recent observations of locally high d_{50}s. The change in replenishment methods with the STI concentrating on removing sand from the upper beach may reduce this sorting influence.

The ALB strategy includes an ongoing program of addition of sand from external sources to the southern beaches, as a measure against sea level rise and other sand losses. The sources identified to date for this sand are not as coarse as the sand dredged onshore from the Port Stanvac source in the previous major replenishment programs.

Figure 5 shows historic changes in d_{50} along the coast.

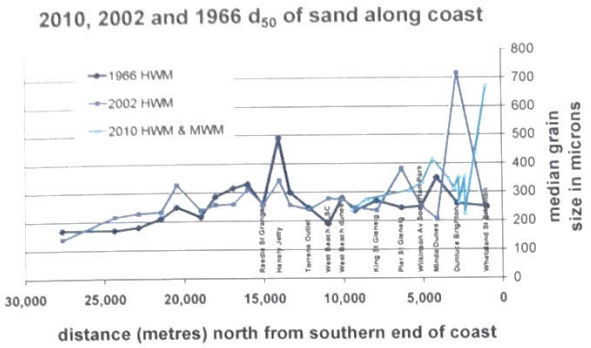


Figure 5: Changes in d_{50} over time; spikes in sand coarseness on the right hand side (the southern end of the coast) are considered to reflect the large dredged replenishment campaigns of the 1990s and are expected to move northward (left) and reduce over time.

Considering the potential variety of sources and characteristics of future replenishment sand, including scope for pre-treatment of sand (such as washing to remove fines) emphasises the desirability that the STI be able to pump a broad range of sands. The large volume of sand already on the beach and effectiveness of the STI in 'recycling' the range of grain sizes accumulated are viewed as influences that narrow the range to be specified for handling by the STI. Monitoring grain size distribution will be part of the ALB strategy.

5. Influence of sand characteristics on hydraulics and pipeline design

Key to the efficiency of the STI project is the concentration of sand able to be pumped as slurry and hence the sizing of pumps, motors and electricity supply infrastructure to achieve its operation. The defining feature for system sizing is the minimum flow rate needed to minimise bed load in the pipes and this is strongly dependent on grain size of the material pumped. Furthermore the range of sand sizes (both in time and within the source deposit) is of critical interest.

5.1 Deposit velocity, slurry concentration and head loss gradient

Methods to estimate deposit velocity for narrow-size distribution sands in various diameter pipes are available such as Wilson and Judge, 1978 [7]. That the sand at Adelaide has been shown to have an occasionally broad size distribution means that simple use of d_{50} to represent the material is not suitable, as large proportions of the sand can be much coarser, with higher deposit velocities. To conservatively estimate the effect of the coarser fraction, an analysis of the system was undertaken using d_m, the 'weighted mean diameter' in place of d_{50}, as documented in Govier and Aziz (1972) [4] amongst others. The d_m is calculated as per Equation 1:

$$d_m = \Sigma\, d_i\, m_i \qquad (1)$$

Where d_i is the median size between two consecutive sieve sizes and m_i is the mass fraction between those two sieve sizes.

The d_m for the November 2009 samples have been calculated and give significantly higher values than the d_{50}. For example the highest d_{50} for the sample set was 0.8 mm and the corresponding d_m is 1.98 mm. The average d_m of all samples in the southern sand management cell is 0.64 mm, compared with an average d_{50} over the same samples of 0.29 mm.

The concentration also influences the deposit velocity. The deposit velocity for sand in a 226 mm ID pipe has been estimated as 3.25 m/s for slurry concentrations above 25% by weight and d_{50} of 0.5 mm. However, if the slurry concentration is reduced to 15%, then the deposit velocity for the material is predicted to reduce to 2.3 m/s. The lower deposit velocity would allow the pumping velocity to be reduced at the lower concentration with consequent reduction in head loss gradient, but would require a longer pumping time to obtain the same solids throughput.

Methods of predicting the head loss gradient for sand-water slurries are described in Wilson et al 2009 [6]. Thomas 1977 [5] discusses the different behaviour of fine and coarse sand and the effects on head loss gradient.

5.4 Pipe wear and roughness

Pipe wear rates vary at between the square and cube of the velocity, so increasing flow velocity in the design to pump the coarse fraction of sand will have a considerable influence on wear rates. Apart from the velocity effect, the coarser particles also increase pipe wear at least in direct proportion to the particle size. These general models are based on the discussion of impact and sliding wear for bed load slurries in Section 11.4 and Figure 11.6 of Wilson et al, 2009 [6].

The hydraulic roughness of the pipe influences the slurry head loss gradient. For example in the dredge slurry pumping trials discussed later in Section 6, the roughness of the used HDPE dredge pipe was found to be around 0.15 mm. This compares with a roughness of around 0.01 mm for new HDPE pipe. For water flowing at 4 m/s in the 285 mm ID pipe the Reynolds Number is 1.1×10^6 and a standard friction factor chart indicates a 43% increase in the water head loss gradient as the roughness is increased from 0.01 mm to 0.15 mm. For slurry, the increase is less because there is a solid friction component. For example for a fine sand (d_{50} = 0.26 mm) slurry at 4 m/s, the increase in head loss gradient is predicted to be 35% when the roughness increases from 0.01 mm to 0.15 mm. For a coarse sand (d_{50} = 0.43 mm) the increase is 24%.

6. Slurry Pumping Trials

6.1 Intent of trials

The prototype scale slurry pumping trials held on the 10th and 11th of November 2010 were instigated to provide head loss gradient information for pumping the fine and coarse sands that occur on Adelaide beaches at a range of slurry concentrations. These full-scale tests aimed to demonstrate the slurry concentrations that could be reliably pumped for the coarser material and the corresponding head loss gradients.

6.2 Description of the trials

A stockpile of 3,000m^3 of selected 'coarse' sand was collected by land plane and carted by truck to the trial location, mixed by dozer, and formed into a pile within the harbour from which the cutter suction dredge could work the seaward face. In an adjacent part of the harbour, there was also a deposit of finer sand (accumulation within the harbour) which the dredge could readily be repositioned to work on. The pipeline assembled for the trial was a well-worn 500 metre long 315 OD HDPE PN8 pipe (ID 285 mm) laid near horizontal along the beach fitted with upstream and downstream pressure gauges and differential pressure (DP) sensors across a 16 m test section, 168 m from the dredge. Flow rate was measured by the dredge's ultrasonic flow meter and by a doppler meter installed adjacent the upstream DP sensor. The dredge's nuclear density meter was used for slurry concentration.

A range of tests were run, including water pumping tests (from 500 to 1,800 m^3/hr flow), coarse sand slurry tests (at 5%,15%, 25%, 35% and up to 55% slurry by weight and flow rates of up to 980 m^3/hr), and fine sand tests (at 25% and 30% slurry concentration by weight). Test conditions were maintained at steady flow and concentration for as long as possible (a few minutes) to endeavour to achieve steady state conditions within the pipe length. At 4 m/s the transit time is 2 minutes.

Source and discharge sands for the tests were sampled for particle size analysis. Pipeline lengths and elevations were surveyed and recorded. General observations such as flow steadiness, discharge material consistency, presence of rocks or shelly loads and periods of high turbidity of discharge were noted.

Details are recorded in Department of Environment and Natural Resources Technical Report 2010/1, DENR (2010) [3].

6.3 Results from trials

Figure 6 compares the dredge trial's coarse and fine sand particle sizings. The respective d_{50} sizes are 0.42 mm and 0.26 mm with the respective d_m sizes 1.42 mm and 0.40 mm.

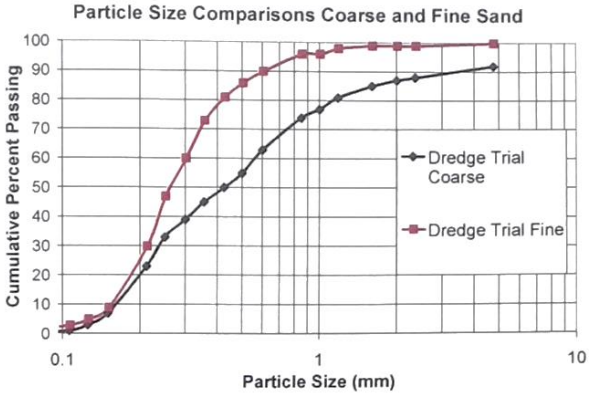


Figure 6: Particle size of coarse and fine sand pumped in dredge slurry pumping trials.

The slurry pumping trials demonstrated that, at a velocity of 3.5 m/s, the pumping of the fine sand was hydraulically similar to pumping clear water; ie the head loss gradient in metres of slurry per metre was similar. However, pumping the coarse sand required the velocity to be increased to around 4.5 m/s to achieve a similar head loss gradient as water and the corresponding head loss to achieve the required velocity was around double that of the fine sand at 3.5 m/s. This is shown in Figure 7. The upper curve is the predicted head loss gradient for the coarse sand, the curve below the prediction for the fine sand and the dashed curve the water head loss gradient.

The predicted deposit velocities are 3.2 m/s for the fine sand and 3.9 m/s for the coarse sand. The coarse sand test data below 3.9 m/s are therefore predicted to involve a stationary bed of particles. The flattening of the coarse data trend and the increased scatter below 3.9 m/s, are consistent with the presence of a stationary bed.

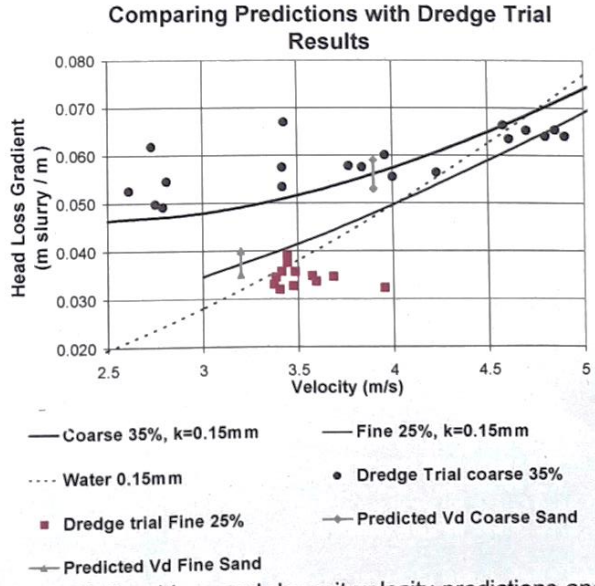


Figure 7: Head loss and deposit velocity predictions and data from the slurry pumping trials. Predictions are based on a pipe roughness of 0.15 mm reflecting the heavily worn pipe used in the trial.

7. Discussion

The sand present on Adelaide beaches exhibits large variations both in d_{50} size and size distribution. Considerable variations occur both longitudinally (along the coast) and transversely (across the beach). The range of sands reflects current and historical influences both natural and man-made. The future sand movement patterns and addition of sand from outside the system will also change sand sizes over the project life.

The selection of the design sand for the ALB STI project needed to reflect the most frequently encountered and more extreme sand characteristic ranges over which the pipeline would need to operate - with the focus on its ability to function in the extreme situations and operate efficiently under most conditions. On the other hand, specifying too broad of range of sand sizes to be handled could result in a design oversized for normal operation and hence less efficient for most of its operation as well as having a higher capital cost.

The ability to collect sand across a wide area of the accumulation beach and so mix coarse sand deposits with finer material is seen as an essential means of managing the characteristics of sand to be pumped. Trials on suitable equipment to collect sand from the beach have shown that using a sand scraper device is effective in providing sand to the pumping system with mixed characteristics from across the available beach width.

The most significant influence on the future sand characteristics of the Adelaide beach system will be the type of sand that is introduced to compensate for the impact of climate change. It is expected that over the 25 year life of the sand pumping infrastructure that sea level will rise by around 150 mm or more, with an anticipated increase in storm intensity, amongst other climate changes. Modelling of drift rates under these conditions indicates increases and the occurrence of erosion hotspots – but that the location of these is not consistent between the various scenarios modelled. The ALB strategy includes the addition of coarse sand from outside sources on an ongoing basis to manage these changes. The offshore movement of sand during storms is very dependent on sand size. Models indicate that, given the same storm conditions, the volume of sand eroded from a beach of d_{50} 0.5 mm sand is only 20% of that removed from a beach of d_{50} 0.22 mm sand.

Specifying imported sand will need to take account of a number of factors including:

- The economics of pumping the sand.
- Resulting beach slope and consequent longshore and offshore sand transport.
- Cost of meeting the required specification.
- Use of less costly, existing finer sand from northern Adelaide beach accumulation.

8. Conclusion

The design sand chosen for the revised PPR for the STI was described as follows:

'For the purposes of this document and system performance under the Contract, the following sand characteristics are to be used:

- *average d_{50} grain size varies between 0.22 mm and 0.50 mm, taking into consideration that this is variable within and between collection sites, and that the sand transfer operation may need to handle up to an average d_{50} grain size of 0.50 mm for extended periods;*
- *maximum d_{50} grain size of 1.00 mm.'*

Recommendations for managing the impact of the varying sand characteristics occurring on Adelaide beaches on the STI include:

- Collecting sand in a cross-shore manner, so that extremes of coarse sand are avoided.
- Monitoring pipe wear, using a removable pipe insert.
- Varying flows to vary the location of pipe wear within the pipe (ie distribute wear more evenly between base and lower sides of the pipe).
- Increase the wear allowance for high pressure sections of pipeline to reduce risk of pipe failure.
- Reduce flows when pumping finer sands.
- Considering the influence of imported sand characteristics on the existing beach sands, and its effect on the economics of pumping the sand.

9. References

[1] Department for Environment and Heritage, (2005), *Adelaide's Living Beaches: A Strategy for 2005 – 2025* November 2005, Government of South Australia ISBN 1 921018 984.

[2] Department of Environment and Natural Resources,, (2010), Past and Anticipated Future Sand Characteristics for Metropolitan Adelaide Beaches Seacliff to Torrens Outlet, *Technical Report 2010/2.*

[3] Department of Environment and Natural Resources, (2010), Pumping Tests Using Coarse Beach Sand: 10, 11 November 2010, *Technical Report 2010/1.*

[4] Govier G.W. and Aziz, K., (1972), *The Flow of Complex Mixtures in Pipes*, Van Nostrand Reinhold, New York.

[5] Thomas, A.D., (1977) Particle Size Effects in Turbulent Pipe Flow of Solid-Liquid Suspensions, *6th Australasian Hydraulics and Fluid Mechanics Conference*, Adelaide, December 1977.

[6] Wilson. K.C., Addie, G.R., Sellgren, A., and Clift, R. (2009), *Slurry Transport using Centrifugal Pumps, 3rd Edition, Springer, 2009.*

[7] Wilson, K.C. and Judge, D.G., (1978), Analytically-based nomographic charts for sand-water flow, *5th Int. Conf. on the Hydraulic Transport of Solids in Pipes*, Hannover, Germany.

The Adelaide Beach Management Review Independent Advisory Panel

[redacted]

Dear Mr Searle & Panel,

I am writing this in more of a hurry than I would like, due to the need to submit this prior to the 15 October 2023 when The Adelaide Beach Management Review Independent Advisory Panel, require the public opinions to be submitted. I have been intending to do research and write about my concerns for at least the last 3 year, because I have seen the negative results over time from Government trying to manage the beaches & causing problems.

I lived at Semaphore from young & regularly went to the beach at Semaphore, Semaphore South & Largs. I moved a little further away about 8 years ago, but still go to the beach. Three years ago during summer I went swimming at Semaphore or Semaphore South regularly after work & on weekends. The last couple of years I went to the beach much less, not because of where I live, but because it is very upsetting to me to see the state of the Semaphore & Semaphore South beach. I know how beautiful it used to be, & it is sad to see the state of it now.

Let me list some of the negative outcomes I have seen from 'beach management', then, I will list probably causes, debunk some myths & suggest some solutions

Negative Outcomes of 'beach management'

Rock hard sand along the beach – from when I was young even when a teenager in the 70's there was a lot of soft sand. When getting closer to where the sea water had washed in, there would be dried out sand where the surface had a dry crust which would break easily under foot because it was cushion be softer sand underneath – there would also be an area of seaweed which had washed up & this would also trap sand & keep the beach soft. Sand in the water at different times would be either flat or had sand ripples, but the sand ripples would squish out under foot, unlike now.

I have seen a reduction in sea shells & variety of sea shells.

The sand dunes are turning to dirt due to planting vegetation. The vegetation has grossly encroached on the beach, obstructed the view of the beach & interfered with the natural movement of sand

The combined carting sand away from the beach & the encroachment of the planted vegetation has caused a sharp drop of beach level & not just at Semaphore but Semaphore South also.

The above conditions are not caused by sea erosions obviously, because as has been recognised sand should naturally build up along these beaches.

If West Beach is has lost sand it is also not due to sea water erosion or wind etcetera, it is because sand dunes have been built on or carted away. I remember sliding down huge sand dunes not far from Marineland when I was young – for there to have been huge sand dunes there in the first place tells me that sand also used to naturally build up there

Although I am not familiar with beaches far south if it is natural that they were rocky & did not have sand why try & fill them with sand now?

Now the solutions

Re-establish low sea walls where absolutely necessary to protect foreshore amenities & buildings e.g. in front of the Palais, surf clubs, side shows

Remove ¾ of on the beach/sand vegetation so that just a **narrow strip** remains, of **low growing** vegetation in front of the sea walls in the sand. The sea walls can vary in height depending on what needs to be protected from storms, but they should not need to be high

Remove the breakwater at Semaphore South & do not put in groynes or breakwaters anywhere else

For beach areas that do not retrain sand (due to buildings being built over the sand dunes & too close to the water) e.g. West beach - cart sand in (do not take from other beaches to do this or in a way to negatively impact other beaches) & over time buy back the land to return it to the beach

Currently, despite popular opinion I am absolutely confident that Adelaide beaches I are not being impacted by global warming & rising sea levels – I have three reasons for saying this:

1. I don't believe the measurements mentioned that were taken of rising sea level is are an accurate picture – I suspect it was not conducted of many years as would be necessary to eliminate normal variations/patterns
2. The tides & the levels of water to the jetties by my observation over the years, have not changed – also please note, it has always been the case that storm waters go over the jetties
3. I remember as a child at high tide combined with big storms it was normal for the sea to come up to the sea wall not frequently lot but it would happen – quite normal

Kind Regards
Lee Grandison

[redacted]

Civic Centre
165 Sir Donald Bradman Drive
Hilton, SA 5033
Tel: 08 8416 6333
Email: info@wtcc.sa.gov.au
SMS: 0429 205 943
Web: westtorrens.sa.gov.au

City of West Torrens
Between the City and the Sea

23 October 2023

Adelaide Beach Management Review

City of West Torrens - Final Submission

Sent via email to: mail@urps.com.au

1. Introduction

The City of West Torrens (CWT) welcomes the South Australian Government's independent review of sand management options to find a long-term solution to coastal erosion across Adelaide's beaches.

The Adelaide Beach Management Review (the review) is being overseen by an Independent Advisory Panel and is responsible for providing its recommendation to the South Australian Government. As part of considering several feasible options that have been shortlisted from the scientific review, the Panel is considering feedback from the community on these options, prior to making its recommendation to government.

The draft submission from the Administration was lodged on 6 October 2023 subject to review by Council, with submission of the Council approved version following the Council meeting of 17 October 2023. Feedback from Council has now been incorporated in this final submission. ***It provides support for the pipeline option, specifically sub options 2.1 and 2.2, rather than supporting dredging (Option 1) or sand carting (Option 3).***

Council's submission is intended to support the review process and to promote a system wide approach to coastal management. It highlights the importance of safeguarding local amenity values, accessibility, positive health and wellbeing, preservation of the fragile coastal and marine ecosystem, while protecting public and private assets.

Council supports a management regime that includes sand nourishment as a component of a holistic approach to coastal management, including seagrass and dune restoration. This approach holds particular significance due to the cumulative effects of climate change on coastal dynamics and erosion, underlining the necessity of addressing uncertainty and enhancing the system's resilience.

2. Background and Issues

The metropolitan coastline forms the western boundary of the City of West Torrens and the significance of this is highlighted in our logo messaging: 'Between the City and the Sea'. Although it is not a long stretch of coast compared to other metropolitan councils, approximately 1.5km, it is the home to important community and government assets, which depend on the ongoing health of the coast, such as the following examples:

- The Coast Park pathway, which is part of our open space network and we undertake care and control of this portion of the regional pathway;

- SA Water's wastewater treatment plan which services metro Adelaide, as well as provides treated wastewater to irrigate many of our parks and ovals, and this helps to green and cool our city;
- West Beach Parks - a key holiday and recreation destination in South Australia;
- West Beach Boat Ramp - provides access for recreational boating;
- Businesses associated with marine and beach activities;
- Recreational activities, such as sailing and visitors to the beach.
- Coastal/dune environment; and
- The nearby Patawalonga, home to dolphins and the site for recreation and relaxation.

Coastal management, including sand management plays a role in safeguarding these important assets and environments.

Council is a member of the Adelaide Coastal Councils Network and is therefore aware of concerns amongst some sectors of the community of the current active movement of sand due to the negative impacts of machinery and infrastructure on the dunes and beach condition (compaction and pollution impacts), public safety (traffic hazards), amenity (noise and nuisance concerns) and road infrastructure (escalating renewal costs). This highlights the need for comprehensive environmental and social investigations to be undertaken as part of the decision making process for future coastal management measures.

3. Shortlisted Options

The shortlisted options for community feedback were presented on the Government's 'YourSay' page, entitled "Have your say on the future of Adelaide’s beaches - Future management options", and are summarised below.

Option 1. Dredging

Sub-options:
1.1 Dredge existing sand near the shore (estimated cost: $45-50m over 20 years)
1.2 Dredge using large offshore sand deposits (estimated cost: $55-60m over 20 years)
1.3 Combination of dredging offshore deposits and trucking quarry sand (estimated cost: $60-100m over 20 years)

The first two sub-options presented above would involve collecting sand from the seabed offshore from the northern beaches using a dredging vessel and delivering it via a floating pipe to West Beach or to other beaches in need of sand. These two sub-options would involve an initial collection and delivery of a large quantity of sand in the first year of operation, taking about 3-4 months to complete. Top-ups would then needed every 4 years, taking about 2 months to undertake. The third sub-option would collect sand using a dredge but also use sand trucked in from quarries. Depending on the quantity of quarry sand used, this would be expected to take about 3-4 months each year for the first 4 or 5 years.

Option 2. Pipeline

Sub-options:
2.1 Pipeline using tractors/trucks on beaches (estimated cost: $140-155m over 20 years)
2.2 Pipeline using dredge pump system on jetties (estimated cost: $140-150m over 20 years)
2.3 Pipeline using a temporary dredge (estimated cost: $140-155m over 20 years)

Sand pumping uses underground pipelines to transfer sand and seawater from beaches where sand is building up to beaches in need of sand. Operating the pipeline would involve collecting sand from the beach or nearshore for 4 months at a time. Quarry sand would be delivered annually over the first 5-year period to restore West Beach.

Option 3. Carting

Maintain current arrangement regime - moving beach sand and quarry sand using trucks and machinery.

Sand would be collected from the beach using an excavator and front-end loader and trucked to areas where sand is required. External quarry sand would be delivered using trucks on public roads. Excavators would be used to move the deposited sand to achieve the desired beach profile. Sand delivery would happen twice a year over 2-3 months. The estimated 20-year cost for this method is $100-110 million.

4. Feedback on the Options

Council appreciates that its feedback on the options will assist the Panel and the project team to further progress work, and that further investigations will be undertaken, such as environmental impact assessments, before a final decision is made by the government.

Although the area of coast within the boundary of West Torrens is relatively small, consideration of the options has taken a holistic, systems based approach. A broad perspective has therefore been used to provide feedback on the options.

Council's feedback aims to protect social and environmental values and has had consideration of the goals of the Adelaide Beach Management Review which include the following:

- Maximise the amount of sand on beaches.
- Minimise disruption for all communities.
- Avoid environmental harm.

In addition to the above goals, it is important that future management measures are flexible so they can be modified over time to respond to issues such as climate change, or can be moved along the coast to respond to priorities as they arise *(Evan Watterson, Bluecoast - presentation to community on 27 September 2023)*. Further, it was explained that options requiring infrastructure and/or have rigid and strict contractual arrangements in place can impede flexibility.

These factors have been considered by Council in providing the following feedback on the shortlisted options.

All of the options will have a degree of environmental and social impact and all will be affected by climate change. Fragile dunes and shorebird habitats need to be protected from disturbance, social amenity values of the beach need to be maintained, and the impacts to marine life and seabed environments need to be investigated to ensure a new problem is not inadvertently created.

As outlined by DEW at the consultation session on 27 September 2023, it is an offence to cause environmental harm under the Environment Protection Act and a full environment impact statement will be undertaken before any option is approved by the government.

The current management of sand is causing concern amongst sectors of the community due to the social and environmental impacts they create. This includes issues relating to noise, visual amenity, sand removal in some areas, and disturbance to shorebirds and their sensitive coastal habitats.

Although detail is currently lacking on information such as sand availability, environmental impacts and licence arrangements, etc, for the options, Council has identified a preference.

At Council's meeting of 17 October 2023, Council resolved to support Option 2 - Pipeline: 2.1 and 2.2 only, being:

- 2.1 - Pipeline using tractors/trucks on beaches (estimated cost: $140-155m over 20 years); and
- 2.2 - Pipeline using dredge pump system on jetties (estimated cost: $140-150m over 20 years)

Compared to the other options, the pipeline option is considered to have a lower risk of disturbing and potentially causing harm to the environment and dune ecosystem, and would better protect the marine and seabed environment. This final submission incorporates Council's support for the pipeline option, replacing the earlier draft submission.

Yours sincerely



Gordon Andersen
Manager Strategy and Business

Appendix F - Key stakeholder workshop verbatim activity comments

Option 1.1 - Dredge Existing Sand Near the Shore

How do you support this option?	Strongly Support	Support	Neutral/ Don't Know	Do Not Support	Strongly Do Not Support
	16	3	2	2	2
What do you like about this option?	• Flexibility • Limited impact on the dunes/beaches • Flexibility – not only in the face of climate change but sand may be deposited where needed – new technology enabled • Limited disruption to community with offshore systems • Perhaps this is the cheapest and easiest option and the sand won't stay there anyway • West Beach and Henley need sand • Dredge option gets trucks and heavy machinery off the beach • Gets trucks and heavy machinery off all beaches • Strongly support the goals of Adelaide Beach Management met – minimising disruption of communities and avoid environmental harm providing turbidity studies and seagrass studies are done. Pleased the sand may be pumped offshore at West Beach to try a different approach than the last 50 years placing sand on the beach				
What don't you like about this option?	• Not genuine option • Limited data, therefore risky to be put up as a viable option • Dredging sea-grass meadows – commercial and recreational fishing, blue swimmer crabs – destruction of habitat • Section bank – POMS – in quarantine – cannot remove sand – when available? • Dredging – placement in surf zone? No scientific basis/not tested – will not rebuild West Beach/Henley Beach profile • Dredging – gulf is a sea-grass meadow – not eastern seaboard with infinite sand supply • Dredging – EPA licences? Plumes? Loss seagrass issue since 1990's • Dredging can stir up sediment leading to turbidity and reduces water quality				
Any other thoughts about this option?	• EIS required				

	• If dredging options get knocked out due to unsuitability of sand sources do we by default get a pipeline? • Want to see and understand the environmental impact before giving 100% support • Dredging – any unanticipated environmental impacts from this option? Out of sight out of mind?

Option 1.2 - Dredge Using Large Offshore Sand Deposits

How do you support this option?	Strongly Support	Support	Neutral/ Don't Know	Do Not Support	Strongly Do Not Support
	15	7	5	1	2
What do you like about this option?	• West Beach and Henley need sand • Flexible – replenish West Beach with large amount of sand • No trucks on any beaches • All dredge options are more flexible and can deal with erosion hotspots in a more adaptable way • Get trucks and machinery off our beaches • Causes less community disruption • More likely to maximise sand staying on beaches • Will do less environmental harm than a pipeline Comment applies to all dredge option				
What don't you like about this option?	• Not genuine option • No real data available to confirm viability • The sand is too silty to be a 'real' source • Dredging surf zone – test with dye first – not rebuilding beach and dunes • Carbon sequestration? State Government's 'blue carbon' • PIRSA trying to regrow seagrass • Engineers talk of 'social licence' – when one group is favoured over another, that is bias and favouritism is not democratic • Not genuinely achievable • Sand dredging has its own environmental impacts – destroying coastal habitats including breeding and feeding species				

Any other thoughts about this option?	• Needs to also deliver some sand behind Semaphore breakwater • Want to see and understand the environmental impact before giving 100% support • Will you spend up to the budget of the other more expensive options in your search for suitable sand? ie if suitable sand can be sourced more than 25km from West Beach, why not spend up to $140 million for a solution that has fewer environmental and public amenity impacts

Option 1.3 - Combination of Dredging Offshore Deposits and Trucking Quarry Sand

How do you support this option?	Strongly Support	Support	Neutral/ Don't Know	Do Not Support	Strongly Do Not Support
	6	10	4	1	1
What do you like about this option?	• Alternative for West Beach to have sand pumped offshore rather than onto beach which hasn't worked for 50 years. Needs environmental study prior • West beach and Henley need sand				
What don't you like about this option?	• Not genuine option – no sand source, no EPA, no EIS • Lacks adequate data • So much seagrass/habitat has already been destroyed along the coastline- why destroy more when it is not needed • No distance off shore stated • Not genuinely achievable • Port Stanvac 2020 – cores showed insufficient sand in clay layers – contaminated - plumes				
Any other thoughts about this option?	• Needs clear EIS				

Option 2.1 – Pipeline Using Tractors/Trucks on Beaches and Trucking Quarry Sand

How do you support this option?	Strongly Support	Support	Neutral/ Don't Know	Do Not Support	Strongly Do Not Support
	31	1	1		22
What do you like about this option?	• Pumping stations and ?? have worked well with little visual impact on the South M?? beaches • Proven method provides needed sand reinstatement • Shares impact across all stake holders • Cheaper over a longer period • This option works perfectly from Glenelg to Seacliff. Why wouldn't it work from Largs to West Beach • West Beach and Henley need sand • Pipeline- very flexible over time, not as intrusive as trucks, reinstates and maintains beach profile in equilibrium. • Only option that recycles sand • Sustainable • It works • Sand pipeline – reinstates beach and inner zone – need West Beach and Henley Beach South in equilibrium • A proven working model on our coast • Costs already known • Infrastructure not affected by political instability				
What don't you like about this option?	• Use of quarry sand • Excavation on beaches for 33% of year • Not flexible environmental disaster, disruption to community, microplastics from pipeline onto West beach and ocean – expensive • No infrastructure on beach – impact on community • No, no no – not flexible, massive disruption to community north and south, doesn't avoid environmental harm, expensive • Not flexible, doesn't address immediate problem at Henley and Grange, doesn't address minimum disruption • Having permanent pump stations that can't be hidden, eg at Henley Beach – impedes views – bad for businesses and state's tourism reputation • Too expensive – no support from community or PAE Council				

	• This option will sterilise the beach, shore birds will disappear • Pipeline options all disproportionally and negatively impact on Semaphore and Largs Bay communities • Source of microplastic with erosion of the pipe with soil movement • This will be a legacy for our children if we don't dissemble the pipeline at its end of life • Likely to become exposed with climate change • Pipeline will deliver sand only to beach face steepening beach face and erosion causing more • Does not cater for Henley Beach – not enough sand to fix West Beach and other erosion hotspots • With shoreline retreat, increased high tides and frequency of storms, rarely a 30 metre wide beach to install pipeline – delays and cost blow outs • Disastrous for tourism, businesses and communities who use the beach • 125 cubic metres of micro and nano plastic particles will be dumped onto beach and washed into gulf waters • Too expensive • Pipeline construction and installation will destroy foraging and nesting areas of threatened species
Any other thoughts about this option?	• Cost reduction if northern beaches sand is used for initial nourishment instead of quarry sand? • Pipeline can be flexible in the future by the method of sand procurement dredge of carting • How did the pipeline get past the STOP phase when this is clear a huge disruption to the environment and impact on the public amenity when harvesting the sand from the beach and in constructing the pipeline? • Why didn't removing West Beach Harbour get more consideration in the rating matrix? • No consideration of loss of fore lines at Semaphore/Largs from previous sand mining. The sand is not coming back • How large is the collection for pipeline use compared to activity on Glenelg Beach at present

Option 2.2 – Pipeline Using Dredge Pump System on Jetties and Trucking Quarry Sand

How do you support this option?	Strongly Support	Support	Neutral/ Don't Know	Do Not Support	Strongly Do Not Support
	1	7		4	21
What do you like about this option?	• West Beach and Henley need sand • How did this option get on the shortlist • Entertainment Value • Dredging/ closing Semaphore & Largs jetties for 4 months is unacceptable and does not minimise disruption for all communities • Better than beach collection sand pumps & outlets have minimal impact on South Coast				
What don't you like about this option?	• Taking sand from jetty will affect structural integrity of jetty • Closing Largs & Semaphore jetties for 4 months. Beach closed around jetty, disruption to community, swimmers, fishing, business. Pipeline is environmental disaster • To expensive no support from community or PAE council • Cranes on jetty? safety? Strength? Modification • The public will not accept the jetty closeness for sand collection • Jetties- SWL –Largs almost land locked would need to be excavated • Disruption to community- closure of Largs & Semaphore jetties 3-4 months year • EPA will kill this option off • The dredge site for near shore mobile sand intake is in an area where there have been creatures spotted such as pipe fish • The jetty at Semaphore & Largs provides habitat for marine life 7 are recreational hubs for snorkelers and fishers. This option should not be brough forward				
Any other thoughts about this option?	• How many people use Semaphore jetty & jetty per day. Impact of closure for 4 months per year?				

Option 2.3 – Pipeline Using Temporary Dredge and Trucking Quarry Sand

How do you support this option?	Strongly Support	Support	Neutral/ Don't Know	Do Not Support	Strongly Do Not Support
	6	4	1	3	18
What do you like about this option?	• West Beach and Henley need sand				
What don't you like about this option?	• Too expensive • Pipeline is inflexible – doesn't address erosion hot spots as they occur • Too expensive – no support from community of PAE Council • A dredge in winter would be limited in operation • Doesn't address the immediate problem with Henley and Grange • Lowers beach level leaving dunes open to erosion with increased storm events and climate change. • Pipeline is an environmental disaster • Plastic and abrasive sand – micro plastics on beach and in ocean – expensive				
Any other thoughts about this option?					

Option 3 – Moving Beach Sand and Quarry Sand Using Trucks and Machinery

How do you support this option?	Strongly Support	Support	Neutral/ Don't Know	Do Not Support	Strongly Do Not Support
	0	5	1	2	17
What do you like about this option?	• West Beach and Henley need sand • Whatever option must reinstate beach equilibrium at West Beach/Henley Beach South and Henley Beach • Trucks – very flexible, puts sand on beach to maintain equilibrium profile – not popular				
What don't you like about this option?	• Noi mass reinstatement of sand • All 3 goals of beach management review are contradicted • Sand is taken and beach is lowered • Community disruption to the maximum • Environmental disaster aiding climate change – beach is lowered, dunes eroded • Unsustainability of sand carting trucks on roads and beaches				
Any other thoughts about this option?	• Would support if 100% sand came from quarries only • Only support 100% quarry sand • Quarry sand would be reduced in volume over time due to increase in m^3 cost				

Anything Else we Should Know?

- Sand should be separate option
- Any option needs to be future government proof – constant supply of sand
- NPV +/- 50%!! Budget costs could decrease by 50% (rubbery numbers)
- The posters names need to match the presentation - where is A3?
- Will there be a call for the public to do the survey via The Advertiser?
- The options as outlined in the online survey do not contain information that is relevant to comprehensively accessing them
- It seems the external consultant has been given a minimal budget and therefore based its findings on many assumptions – how can this lead to a decision based on fact and current data, including environmental impact studies = ill informed decision

SHAPING
GREAT
COMMUNITIES

URPS