ADELAIDE BEACH MANAGEMENT REVIEW IMPLEMENTATION PROJECT

Technical Peer Review

FINAL REPORT – 15 MAY 2025

Rodger Tomlinson
Professor Emeritus

1. INTRODUCTION

The Adelaide Beach Management Review was the outcome of an election commitment to review sand management practices employed on Adelaide's beaches. The review was administered by the Department for Environment and Water with oversight provided by an Independent Advisory Panel.

A key component was a desktop scientific review of Adelaide beach management by Bluecoast Consulting Engineers, which collated information on coastal processes and historical management practices to 2023. Based on this work, the ABMR Independent Advisory Panel recommended the following:

- Restoration of West Beach using external sand within 5 years
    - This will require investigation of dredging from offshore sources, verifying the availability of suitable sand sources, assessment of environmental impacts, and viability of operations and approvals.
- Recycling of sand between the northern beaches and West Beach
    - This will require investigation of the feasibility of dredging nearshore or nearby sand deposits as a long-term, sustainable method to deliver sand recycling: verifying availability of suitable sand in the littoral zone and the operational viability and constraints for environmental approvals.
        - If viable, assess against sand recycling pipeline option to determine the best long-term, sustainable sand recycling option.
        - If not viable, seek relevant approvals to implement the sand recycling pipeline.
    - Implementation in the interim of sand recycling via sand carting using trucks to manage the build-up of sand at the northern beaches.

In direct response to these recommendations, a dredging trial was undertaken in late 2024 and early 2025 in parallel with sand carting from quarries. A raft of reports has been prepared and made available discussing these activities and their outcomes. Those examined here are listed in the Bibliography.

The purpose of the Technical Peer Review which follows is to assess the accuracy and robustness of the elements of the recommended beach management strategy from a technical and process point of view with regard to the key documents informing feasibility of three sand management methods - sand carting, pipeline and dredging, supported by historical information and targeted studies.

2. BACKGROUND

Beach management along the Adelaide coastline has been dominated over the past five decades by beach nourishment, either mass nourishment or sand backpassing (recycling). These strategies have been supported by coastal process studies, sand movement modelling, and environmental assessments.

While the focus of this Technical Peer Review is the components recommended by the Adelaide Beach Management Review Independent Advisory Panel (the Panel) in 2023, the following provides a brief overview of the understanding of Adelaide's coastal processes and the various management activities and reports which lead up the findings of the Panel.

As background to this Technical Peer Review a number of reports, memoranda and papers, as listed in the Bibliography, have been reviewed.

Assessment of coastal processes including management options commenced in 1970 with the Culver Report and have culminated in the Adelaide Beach Management Scientific Review (Bluecoast, 2023).

The Bluecoast (2023) report provides a comprehensive summary of all that had gone on before and offers the scientific basis for the recommendations of the independent Panel. This report is professional and stands up to peer scrutiny.

Historical studies have identified the main aspects of coastal processes along the metropolitan coastline. In simple terms the dominant process shaping the beaches is longshore sand movement to the north driven by southerly wave action in the Gulf.

If the beaches were left in a natural state, they would maintain an "equilibrium" profile with a projected future reduction in sand availability due to sea level rise.

However, with early urban development effectively "trapping" sand by locking up the foredune systems, and with more recent construction of boat harbours and other coastal structures, there have been changes in longshore transport rates and the development of sections of the coastline that have become persistently eroded. This became particularly apparent for West Beach.

In the first half of the 20th century, seawalls were constructed for erosion protection. In the decades since the 1970s, management of erosion has been based around trucking sand to the eroded beach. This sand was sourced either from terrestrial quarries or from the downdrift beaches. In 1992, the Coast Protection Board reviewed the overall management strategy and recommended a continuation of nourishment with a suggestion to source the sand by dredging the offshore region.

There was ongoing erosion of West Beach in the 1980s – exacerbated a major storm in 1985. Boat harbours, groyne, bypassing and backpassing systems and further seawall construction followed culminating in the construction of the offshore breakwater at Semaphore in 2005-2009.

Erosion of West Beach became the focal point of concern, and an assessment of longshore transport rates clearly showed the interruption to sand supply from the south due to harbour construction in 1996-97 and the commencement of backpacking in 2011 (DHI 2018).

Coastal process modelling studies by Coastal Engineering Solutions (2004), DHI (2018) and recent sand budget analysis by Bluecoast (2023, 2024 and 2025) have provided the basis for quantifying sand movement. These studies have been supported by coastal monitoring, sand source characterisation and source quantity assessments.

The primary parameter influencing coastal processes and the feasibility of management options is sand characteristics, with grain size being the critical component. Considerable effort has gone into sampling sand in the region with results from these studies enabling a near-definitive assessment of spatial sand characteristics along the Adelaide coast.

3. REVIEW OF KEY DOCUMENTS

Three key documents underpinning advice to government with be peer reviewed, namely:

1. *Feasibility of dredging*
2. *Feasibility of pipeline*
3. *Feasibility of sand carting*

3.1 Feasibility of Dredging

The "Sand management using dredgers – sand sourcing and other feasibility assessments - Adelaide Beach Management Review Implementation Project" 2025 report prepared by Bluecoast assesses the long-term feasibility of carrying out future sand management activities on Adelaide's northern metropolitan beaches using dredgers.

This report builds on the Bluecoast (2023) scientific review and resolves a number of uncertainties to address the questions:

i) Can West Beach be restored with 'external' sand using dredging from suitable offshore sand deposits as the preferred alternative to the use of importing quarry sand? and

ii) Can dredgers be used to recycle sand from nearshore deposits on the northern part of Adelaide's metropolitan beaches as the preferred long-term alternative to the use of a sand recycling pipeline?

In addition to addressing the feasibility of dredging, the report brings together the preliminary findings of the dredging trial of 2024–2025; recent studies investigating the important issue of sand characteristics suitable for nourishment; a reanalysis of the 2023 sand compartment budgets; and, identification of sand deposits suitable for nourishment. The report collates sand sampling undertaken in the past and as part of the ABMR Implementation Program, providing a whole-of-northern management area distribution of sand characteristics.

An examination of external sand deposits against the desirable sand characteristics criteria established in Bluecoast (2024) resulted in two external locations deemed suitable:

i) the sand deposit north of the port's approach channel, which is north of and external to the West Beach to North Haven littoral sand movement system, and

ii) the sand deposit located just offshore of West Beach. This sand deposit is located offshore of the -5m AHD depth contour and outside the active sand movement system.

Around 1 million m^3 is estimated to be available for West Beach Restoration. These two sites were assessed favourably against operational and environmental constraints.

Nearshore deposits in the inter-tidal zone inshore of the -5m AHD contour were assessed for recycling suitability. A number of sections between Torrens Outlet and North Haven were deemed suitable but requiring further investigation of suitable available sand quantity and quality. These sites were similarly assessed against environmental and operational constraints.

The report provides an update on the sand budget analysis based on recent data and considers the buffer width requirements against storm erosion. From this assessment, an estimate of 100,000m^3/year is available for recycling while still maintaining 2024 shoreline position.

The report presents a very comprehensive description of dredging and placement methods listing advantages and disadvantages. The analysis recommends the use of a Trailing Suction Hopper Dredge for the offshore deposits and some of the nearshore areas with Cutter Suction Dredges being suitable for shallow area. Placement via bottom dumping or pumping ashore are discussed.

Based on their assessment of sand deposit locations, dredging and placement strategies, Bluecoast identify 90,700m^3/year available for recycling and 1,192,000 m^3 available for restoration. Costings for operational strategies are provided.

3.1.1 Dredge Trial Supporting Reports

Reports on noise, environmental issues, water quality, operations and marine mammals (see Bibliography) have been reviewed and provide assessment of the recent trial. The outcomes are generally positive and not unexpected based on similar dredging activities elsewhere.

Operational noise levels above and below the water were negligible and water quality impacts were acceptable.

SWASH (2025) provides a detailed assessment of the operational issues which have been taken up by Bluecoast (2025) above. Although only 65% of the targeted quantity was achieved, this would seem reasonable given the operational constraints of the small Cutter Suction Dredge used.

3.1.2 Peer Review Comments

The “Feasibility of Dredging” report is a comprehensive assessment of dredging as an option for both restoration of West beach and recycling. It presents a solid summary of past studies and supports previous work by including recent sand sampling describing characteristics and available quantities needed to inform all sand management options. The report is technically robust and reflects current coastal engineering practice for beach nourishment projects. Limitations, constraints and opportunities have been identified and presented in clear logical manner. The preferred operational aspects of the different equipment and strategies for nourishment reflect common practice in that TSHDs have more flexibility for operations in deeper water and CSDs have more flexibility for nearshore work.

Section 7 of the report has articulated some important issues for whole-of-coast management. Addressing the system as a whole-of-coast problem will be important for the future, in that while dredging to restore and recycle to address current West Beach issues is supported, a more integrated focus will be needed between the northern and southern management areas in the future.

It should be noted that Bluecoast’s sand suitability criteria for recycling and beneficial reuse are desirable, but not an absolute restriction on sand sourcing. For example, the current issue of the EBA2 shoal is a case in point. The grain size and quality of sand in the shoal meets the desirable criteria, and is easily accessed, however if it is not used then the only alternative may be less desirable (but acceptable) sand requiring larger volumes and at a higher delivery cost.

With respect to the assessment that EBA2 should be used and based on the information reviewed, the shoal has been growing for some time and in recent times appears related to the deflection of longshore current at the harbour. A deflection of this nature would transport coarser material (with the desired D50) into deeper water due to an acceleration of the current. The existence of the shoal prior to the harbour may have been due to a low-relief reef further offshore. The depth of the shoal would suggest that there is negligible cross-shore transport under typical wave conditions and the shoal is not part of the active shoreline processes.

Therefore, the proposed dredging strategy of "shaving" the edge off the shoal is not likely to create any negative impacts on the shoreline, which is of significant community concern. There are clearly cost advantages of using this sand. Use of EBA2 for ongoing nourishment could be managed by establishing targeted monitoring with triggers set in the event of any possible de-stabilisation of the shoal (or shoreline).

The use of dredgers, both offshore and nearshore, is very common worldwide and is the primary strategy used on the Gold Coast for over 40 years.

The report convincingly demonstrates that dredging will deliver the required restoration volumes in the shortest timeframe compared to sand carting or pipeline and be suitable for recycling. Large scale nourishment by large (ocean-going) TSHDs is an efficient option for one-off restoration, although establishment costs can become prohibitive.

The main advantages of this option are the flexibility in choice of discharge locations, dredger capability (dependent on availability and sand source location) and alternative discharge methods such as bottom dumping, rainbowing or pipe-to-shore.

The disadvantages may include the high establishment of should large dredger be used, their availability when required and operational constraints due to weather. As with all options there will be a requirement for some equipment on the beach to re-profile deposits, however nearshore discharge form a dredger may also require sea-based options such as sand scraping to move deposits into the upper beach.

As dredging will operate in the offshore region primarily, sand sources that meet the sand characteristics guidelines may become depleted at a rate much greater than natural replenishment.

3.2 Feasibility of pipeline

The "DRAFT Sand pumping system feasibility assessment" (2025) report was prepared by HATCH. The purpose of this report is to:

i) *Review the existing design of the SOC Sand Pumping System,*
ii) *Review relevant new information, in particular data from more recent sand source investigations and coastal process monitoring, to verify sand characteristics and sustainable extraction volumes in the vicinity of proposed sand collection units,*
iii) *Assess the feasibility of the designed SOC sand pumping system to achieve ABMR Panel Recommendation 2 (recycle 90,000 m^3 per annum to West Beach from northern beaches)*
iv) *Consider implications of any changes on regulatory and operational feasibility, and outline timeframes and additional costs incurred to deliver a revised Sand Pumping System.*

The report discusses the previously approved pipeline from Semaphore South Breakwater to West Beach and proposes a new section from Semaphore South Breakwater to Largs Jetty. An assessment of the sustainable extraction quantities at proposed Sand Collection Unit sites in this system concludes that only 60,000 m^3/year of sand with desirable characteristics for nourishment would be available.

The report presents number of options to increase this to the recommended 90,0000m^3/year. These are to i) reinstate the previously constructed pipeline (in 2013) from Torrens Outlet to West Beach, ii) Extend the pipeline to Largs North, or iii) to extract higher volumes from the system with potential for increase erosion beyond the preferred level of 80m^3/m above +1m AHD buffer.

The report provides detailed information on infrastructure requirement and costings for the pipeline, SCUs and pumping stations as well as operational costs. Sand availability quantities have been determined form DEW profile survey analysis and sand characteristics (Environmental Projects, (2022), Salients (2021) (2019), DEW) which meet suitability criteria recommended by Bluecoast (2024).

3.2.1 Peer Review Comments

This report presents a detailed assessment of the requirements to have a pipeline extending from the sustainable sand sources to the north down to West Beach. The analyses undertaken for sand quantities are based on the best available quantity and quality information, resulting in an estimated 20-year recycling capacity at the recommended rate of 90,000m^3/year.

The report relies appropriately on consultation with contractors and other relevant organisations. The design parameters and capital and operational costs seem realistic. The limitations and constraints - namely the need to refine sand source information, assumptions regarding construction and the need for new approvals – are detailed.

Pipeline systems exist elsewhere in Australia (see Bluecoast 2023) with, for example, the approximately 7km sand backpassing pipeline system being commissioned to provide 120,000 m^3/year to the northern Gold Coast beaches. It should be noted that portions of that pipeline which run along the dunes were damaged in the recent tropical cyclone event.

The main advantage of this option is that once constructed, there is a permanent delivery system with discharge locations chosen to best effect. The main disadvantages with pipeline construction are the disruption to the beachfront during construction and revegetation, the timeframe for construction and approvals, limited capacity to respond to extreme erosion events, and the ongoing maintenance costs associated with pumping station, SCUs and pipeline durability.

Operational capacity would be limited to recycling only.

3.3 Feasibility of Sand Carting

The report titled "Adelaide Beach Management Review Implementation Program 2024-25 DRAFT Report on the feasibility of sand carting to 1) Restore West Beach, and 2) Recycle sand in the Northern Management Area" (2025) was prepared by the Department of Environment and Water. The aim of this report was to:

- *Document the previous coastal management practice of recycling beach sand by trucking (sand carting) and the delivery of the restoration volume of external quarry sand by trucking.*
- *Discuss the challenges and opportunities of the program to date, with a view of considering the feasibility of utilising these practices to contribute to the sustainable management of Adelaide's beaches.*

The report notes that up until the last decade the focus of sand carting has been to mass nourishment the southern beaches with a major campaign in 1997 sourced from Port Stanvac. Now the focus is on the Northern Management Area, with approximately half a million cubic metres of quarry sand delivered since 2021.

The report provides details on carting equipment used to date as well as the cost, being in the range of $31.80 to $61.69 per m^3. The report lists the limitations and opportunities associated with carting via trucks from quarries and notes in particular the sheer number of truck movements through suburban streets and the need for double handling of the sand. Also identified are the approvals and procurement processes.

Sand carting for recycling along the coastline has also been undertaken since the 1970s with the focus shifting to the northern beaches following the construction of the backpassing pipeline from 2014. Since then, approximately one million cubic metres has been moved. The report lists equipment and costs, being from $20.30 to $26.45 per m^3 for delivery to West Beach. Again, the report lists limitations

and opportunities associated with recycling as well as the approvals and procurement processes, noting improvements made over time to limit disruption and public safety issues of large machinery working on the beaches.

The report concludes with a succinct summary of the program of sand carting to date.

3.3.1 Peer Review Comments

The purpose of this document is stated to serve *as 'base cases' for the options analysis*. In this regard, the report provides sufficient detail, particularly of the critical areas of cost and operational limitations. Sand carting is used world-wide, including very recently as an emergency response to coastal erosion caused by Tropical Cyclone Alfred on the Gold Coast. In this case, sand was carted from a stockpile placed over a decade ago for such a requirement.

The strength of the sand carting option is that the operational aspects are well understood as are the costs.

The weaknesses include the high cost (particularly from distant sources in the case of quarries) which often precludes the use of this option. Also of concern is the community disruption (trucking through suburban streets and beach amenity) which has been an ongoing issue for decades on the Gold Coast.

The timescale for delivery of restoration volumes would be prohibitive.

4. OVERALL COMMENTS

The Adelaide metropolitan beaches are typical of open coast environments in that they are subject to irregular storm erosion, persistent longshore sand transport and a history of coastal protection measures. Seawall construction in the first half of the 20th century dominated with some strengthening of these defences in recent years. Since the 1970s beach nourishment has been undertaken to maintain beach width at vulnerable areas, in particular from external sources such as terrestrial quarries and offshore sand deposits. Other nourishment strategies acknowledge the dominant coastal process of longshore drift to the north and recycle or back pass sand from the north to the south.

Both nourishment from external sources and recycling are common practices worldwide as discussed in Bluecoast (2023). Coastal process studies (eg DHI (2018), Coastal Engineering Solutions (2004)) in recent years have provided technically competent quantitative assessments of longshore transport rates and storm erosion to support management strategies.

Bluecoast (2023, 2025) have taken the available quantitative information on past nourishment and the modelled longshore transport rates to develop a sand budget for the whole coastline. The budget reflects the period from 2008 to the present and consequently does not include earlier extreme event (eg 1985). Extreme events will transport sand further offshore to depths where calm weather onshore transport may be reduced, increasing the overall long term sand deficit on the beach and thereby increasing the required quantities of nourishment. Although this impact of extreme events is difficult to quantify, the sand budget methodology is an effective method for providing an overview of areas of concern, and follows on from a recent sand budget developed for the Gold Coast by Bluecoast, for example.

In terms of continuing a sustainable extraction of sand for nourishment (external or recycled) for the Northern Management Area, the key issues are the quantity of available sand (offshore, from quarries or from downdrift deposits) and the quality of the sand at these sources. Considerable effort has gone into sand sampling along the coastline by DEW, particularly as part of the recent dredging trial.

Whilst offshore deposits are of concern for the feasibility of dredging, sand quality affects all sand management approaches - sand carting, pipeline and dredging. Earlier nourishment campaigns appear to have not been overly concerned with sand quality with the sand grain size parameter varying depending on source.

Bluecoast (2024) have now established a set of guidelines of criteria for suitable sand characteristics which are compatible with the native sand at West Beach. It must be noted that strict application of these guidelines significantly constrains sand sources. For example, studies show that sand grain size varies along the coast and along offshore transects with predominantly fine sand occurring at the northern end of the compartment.

The sand sampling and hydrographic surveys however have identified significant quantities of sustainably extractable sand which meet the characteristics criteria which would support restoration of West Beach and maintain a recycling program for over 20 years into the future.

Based on the sampling evidence, the recommendations of Bluecoast (2023, 2025) to only source sand for West Beach that meets the characteristics criteria guidelines are technically sound. However, in the future, sand reserves that meet these criteria may diminish through ongoing nourishment, sea level rise or other impacts. Although coarser sand is preferable for nourishment, the sampling studies have shown that most of the sand in accessible deposits is significantly finer. This is evident at the northern end of the littoral compartment at Largs Bay where the finer fraction of beach sand is transported and deposited. Given that beach sand at the northern end has its origins in the south and is winnowed under longshore transport and wind-blown processes, it is reasonable that the finer sand could be used for restoration and recycling, albeit acknowledging the need to overfill.

5. SUMMARY OF FINDINGS

The background reports provided for this Technical Peer Review have addressed past nourishment campaigns, coastal process modelling, sand sampling and environmental issues. The technical work represented in these reports (and in the key documents) is technically robust and follows appropriate coastal engineering approaches (modelling, monitoring, sand characterisation, sand budget, quantification of artificial contributions i.e. nourishment. Work done is sound and provides sufficiently robust information to enable assessment of proposed sand management options.

Although additional work is not required currently for options assessment, the recommendations of Bluecoast to continue sand source investigations is supported. Studies to date suggest there is enough for immediate restoration and 20 years of recycling, however this may change with sea-level rise and as sand sources which meets the suggest guidelines diminish. The sand characteristics guideline may need to be expanded include to access finer D_{50} sand which is considered reasonable given that the finer portions in the north of the compartment have their origins in sand form the south being winnowed during longshore transport.

Each of the three key documents (including supporting reports) appear to be based on the best available information and have identified adequately the limitations, constraints and opportunities associated with each option. There have been appropriate assumptions made in regard to technical details (eg. Pipeline location, machinery availability) and costs. Environmental constraints, approvals and procurement matters have been adequately identified.

In summary:

- There is sufficient information available from studies done to date to be able to make informed decisions on options.
- The **Feasibility of Dredging** report is comprehensive and detailed in assessing dredging options and has overcome earlier uncertainties associated with this option. It adequately addresses the recommendations of the ABMR Independent Advisory Panel. This option is considered the preferred option to deliver the restoration sand volumes at West Beach in a timely and cost-effective manner.
- The **Feasibility of Pipeline** report is reliant on assumptions regarding required approvals and detailed costings. However, the report provides sufficient detail for comparison with other options being considered.
- The findings of the **Feasibility of Sand Carting** report are backed up by historical information and are adequate for consideration of carting from either quarries or from beach sources as an option for the restoration of West Beach and/or regular recycling.

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