

Stockton Beach erosion, causes, solutions and obstacles

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Stockton Beach is a sandy barrier peninsular, located immediately north of Newcastle Harbour. Stockton Beach is also one of the most serious “hotspots” of coastal erosion on the NSW coast. This paper discusses the scale of the erosion problem, its causes, possible solutions, and the obstacles that prevent a timely management response.

Scale of the Problem: Bluecoast (2020a) conducted a study of the entire Stockton Beach compartment as a Stage 2 investigation for a NSW Coastal Management Program. A sand budget constructed as part of this study found that northward longshore transport out of the southern Stockton compartment was removing 146,000 m³ of sand annually. Analysis of 152 years of bathymetric survey data showed that for the two southernmost compartments at Stockton, sand volume loss was around 8.5 million m³ (Figure 1).

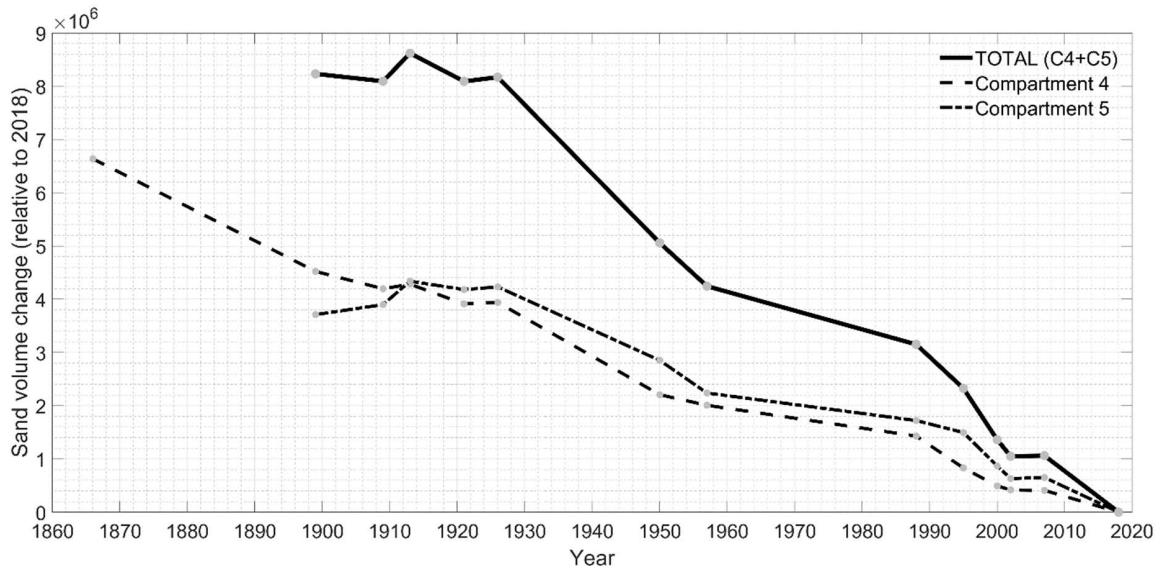


Figure 1. Subaqueous sand volume change in two south Stockton compartments based on bathymetric surveys between 1866 and 2018 (Bluecoast, 2020a).

The shoreline in these compartments retreated around 100 m between 1952 and 2020, but the majority of sand volume loss was from the ebb tidal delta of the Hunter River that deepened from around -2 m to -12 m in locations as far offshore as 1 km. In contrast, the equivalent compartment at Nobbys Beach on the south side of Newcastle Harbour has accumulated around 2 million m³ since 1957. The rate of beach erosion has increased over the past decade, resulting in the removal of the North Stockton daycare centre, one of Hunter Water’s sewage settling ponds, 16 accommodation cabins and most of the frontal dune from the Stockton Caravan Park (Figure 2), subsidence of the mid-beach seawall and removal of all sand in front of it, extensive dune scarp retreat elsewhere and increasing overwash events carrying seawater down residential streets.



Figure 2. Erosion in March 2022 at the site of the Stockton Caravan Park where 18 residential cabin sites, the frontal dune and coastal vegetation have been lost. Picture taken from Stockton SLSC which no longer has beach access for safety craft or training.

Cause of the Problem:

Numerous studies over the past two decades including Umwelt (2002a), Worley Parsons (2011, 2012) and Bluecoast (2020a) have identified the interruption of longshore transport and natural coastal processes by the Newcastle Harbour breakwaters and navigation channel dredging as the primary cause of erosion in the southern Stockton Beach compartment. Simply stated, wave-driven longshore transport is removing 146,000 m³ of sand annually from the southern Stockton compartment, while interception by breakwaters and navigation dredging is preventing or removing any resupply opportunities. In its original configuration (Figure 3), sand was transported northward into the Hunter channel both between and around Nobbys Island, eventually arriving in the flood and ebb tidal deltas at the river mouth (#s 2,3,4,5,6 pre-1866 processes). Now sand accumulates at Nobbys Beach on the south side of the harbour or must travel into deeper water over 1 km offshore (#s 3,4,8 2020) to enter the harbour channel where it is unable to escape the 21m deep trench from which it is subsequently dredged. In the meantime, the former Hunter River ebb tidal delta has been cannibalized (#10, 2020 processes) to provide the sand supply for the northward longshore transport system. This situation is conceptually similar to that operating at the Tweed River mouth, but different to other NSW hotspots such as Wamberal and Collaroy that lack major infrastructure control over their coastal zone. The Stockton Beach erosion problem is thus primarily NOT a response to climate change, sea level rise or inappropriate development (buildings at Stockton were originally constructed over 100 m landward of the shoreline).

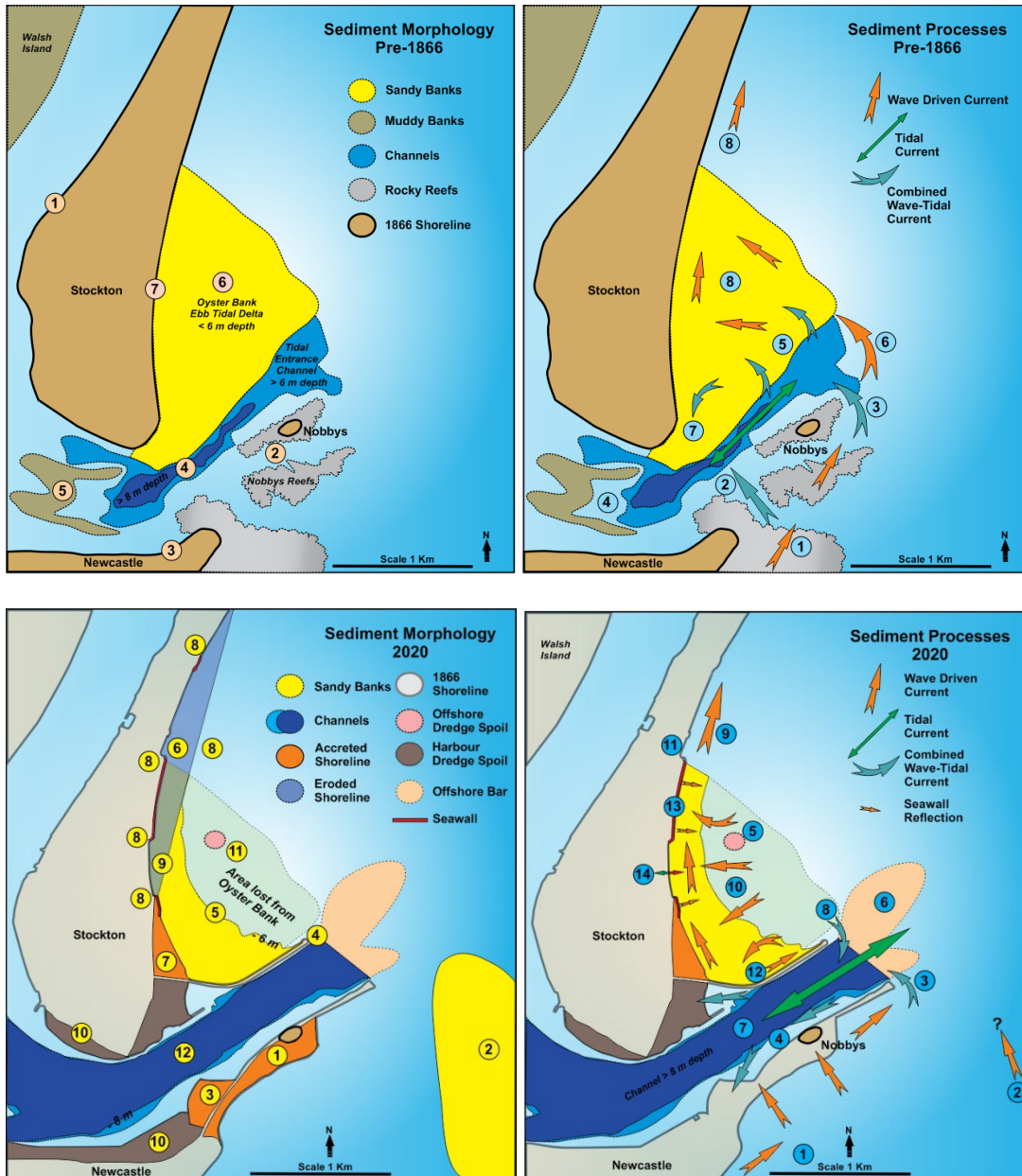


Figure 3. Morphological and process summary of changes in sediment transport at the entrance to Newcastle Harbour, 1866-2020. The construction of breakwaters has prevented sand bypassing the harbour entrance. The Oyster Bank ebb tidal delta has been reduced in area by 50%, deepened by 10 m, and the beach has retreated over 100 m. The entrance channel is now much longer, deeper and wider, creating another barrier to sand bypassing. Northward longshore transport (#9 Processes 2020) is estimated at 146,000 m³ per year.

Solutions to the Problem:

A range of consultants' reports (e.g., DHI 2009, Worley Parsons 2011, 2012) and the City of Newcastle Stockton Coastal Management Program (2020) have identified potential solutions to the Stockton Beach erosion problem. These have included seawalls, headlands and groynes, offshore reefs, sand backpassing and sand renourishment, plus sand renourishment combined with the other options. Seawalls alone have generally been seen as the least suitable option as they are not favoured by the local community, have

historically resulted in the loss of all beach and dune sand at their seaward side and provided a focus for erosion at their margins. In virtually all evaluations, sand nourishment with ongoing resupply (Figure 4) has emerged as the option with highest cost benefit ratio and approval (Bluecoast, 2020b). Other combinations of sand nourishment with headlands, reefs and backpassing have also scored highly but are more expensive. Between 1.8 and 4.5 million m³ will be required, and sources for sand nourishing have canvassed offshore and harbour options, as well as third party supply from quarries and tunnels. The NSW Department of Regional NSW Mining and Exploration Geophysics section (MEG, 2021) completed a study of the offshore sand resources and concluded sufficient and suitable sand was available immediately offshore and to the north of Stockton Beach. Approvals for the T4 coal loading berth in the South Arm of the Hunter River have also identified sufficient and suitable marine sand to nourish Stockton Beach. Both options are considered economically viable with costs of around \$10-20/m³ compared to onshore quarry options of over \$50/ m³. However, all options require capital expenditure of between \$20-30M to nourish Stockton Beach.

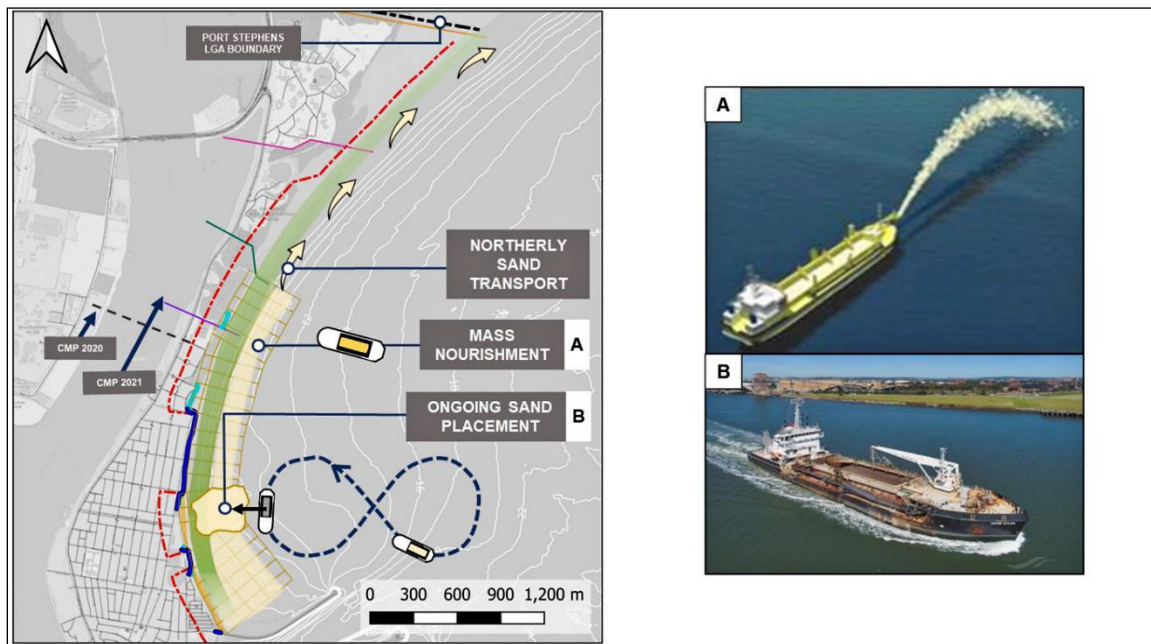


Figure 4. The preferred solution to Stockton erosion problems (City of Newcastle and Bluecoast, 2021).

Obstacles to a Solution:

It is well recognized that coastal erosion at Stockton is a serious problem, and it has been designated a “Significant Open Coast Location” or coastal erosion “hot-spot” by the NSW Government. The problem is not new and has been critical since at least the decades of the 1940s and 1950s, identifying slow response time, ongoing inaction and lack of decision making as the chief impediment. Since 1966, there have been 20 consultant reports prepared for local and state governments on the problem. In 2020, a Coastal Management Program was submitted by City of Newcastle, identifying the issues and proposing solutions. Yet in 2022 the erosion problem still exists, is worse than at any time in the past, and no major remediation has yet occurred. What explains this lack of action? There are

numerous obstacles to a solution. Chief of these is a lack of sufficient, appropriate funding. Funding of \$20-30M is clearly beyond the scope of local government to deliver for a single project. Funding of \$20-30M would also take up much of the remaining NSW Government funds available under the Coastal and Estuary Grants program, designed to cover Coastal Management Programs for all of NSW. Yet there is a vast mismatch between the income generated from the source of the erosion problem (Newcastle harbour breakwaters and dredging), and the expenditure needed to solve the problem. In 2016, the NSW Government leased Newcastle Harbour for 98 years to a consortium of local business and Chinese Merchants for \$1.75B. Coal royalties for exports through the Port of Newcastle average around \$1-2B per year (Australia Institute, 2017), depending on coal prices. The expenditure required to remediate the problem represents less than 2% of the annual royalty or original lease sale income. Meanwhile, total expenditure on interim maintenance and emergency works and further studies is approaching 50% of the final project cost. Another major obstacle is a lack of clarity on who is responsible to fund and deliver the solution. Responsibility rests with the City of Newcastle together with NSW Government Departments of Crown Lands, Environment, Planning, Regional NSW, the Port of Newcastle together with the Commonwealth Government that controls dredging and sea dumping, and the various additional landholders along the coast including Hunter Water, Defense Housing, and NSW Department of Health. This problem is exacerbated by the likelihood of offshore sand being the preferred solution for beach replenishment. Offshore sand is a resource in NSW and comes under the same legislation as onshore resources for exploration and development, such as coal and gold mines. As yet, no clear path has emerged regarding which entity should be the proponent of an offshore mining license and incur the associated expenditure required to conduct exploration and environmental impact assessments, as well as managing an offshore mining operation. This, despite offshore dredging for beach replenishment being standard practice since the 1960s in adjacent Queensland waters, and currently throughout the world in locations such as the Netherlands and Sri Lanka.

Proposal:

Given the lack of significant new sand currently being naturally delivered to beaches on the NSW and Queensland coast, the existence of 16 designated Significant Open Coast Locations on the NSW coast, all experiencing critical beach erosion, and the expected future increase in sea level and extreme coastal storms (IPCC 2022), it seems time to provide a unified rather than piecemeal management solution to the ongoing problem of coastal erosion. Previous mapping (e.g., Boyd et al., 2004, Whitehouse, 2007) and recent investigations for offshore dredging at Stockton (MEG, 2021) indicate that there are abundant and affordable sand resources on the Queensland and NSW inner shelf suitable for beach renourishment. The most likely and appropriate solution to the problem of coastal erosion in eastern Australia is for a consortium of state, local and federal governments to periodically contract an offshore dredge to move along the coast to supply sand to all erosion hotspots between Queensland's Sunshine Coast and NSW's Batemans Bay as an ongoing environmental management strategy.

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