Currumbin Coastal Processes Assessment - Summary Report

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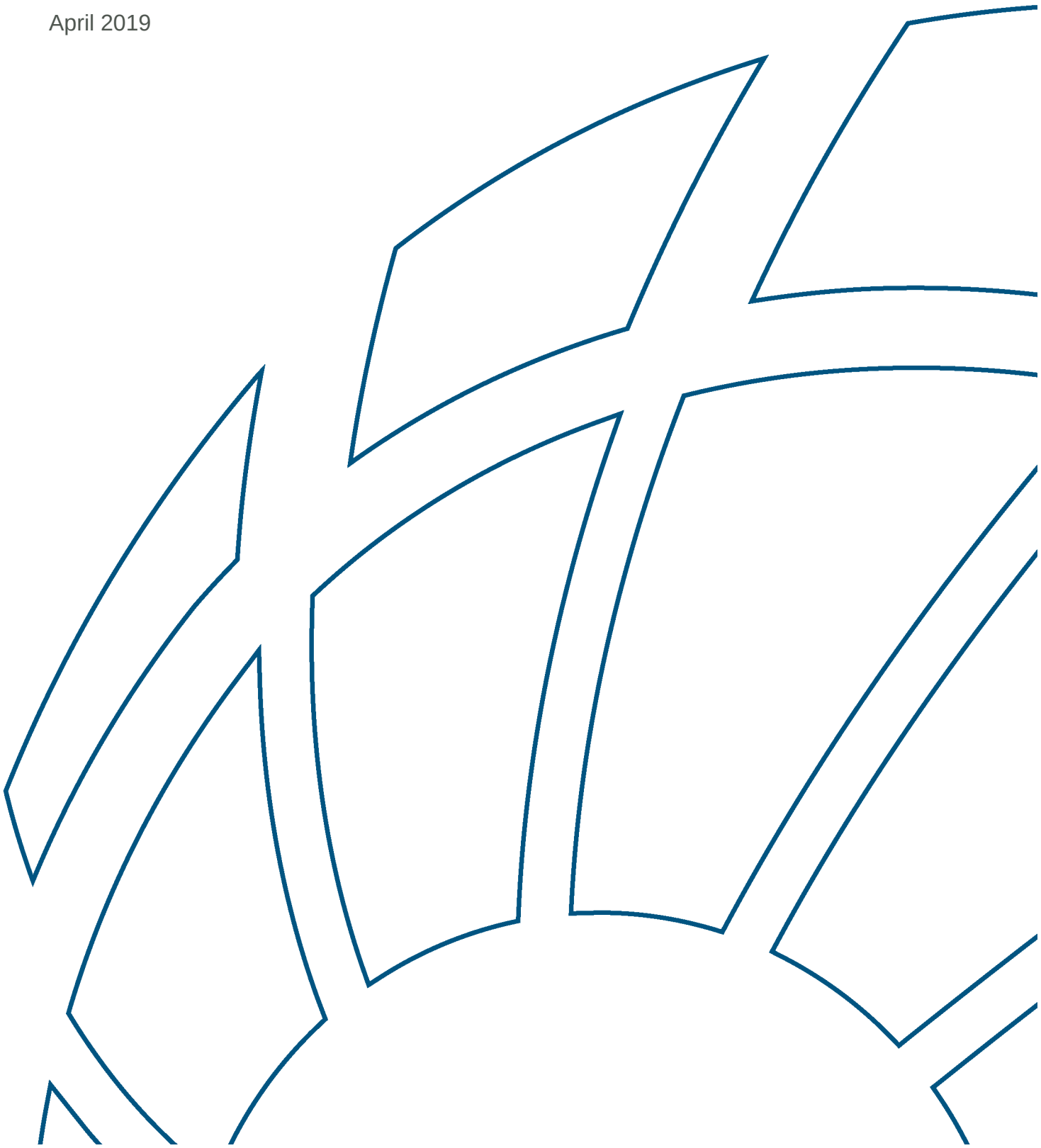

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Synopsis: A summary of the historical and anticipated future evolution of the beaches around Currumbin with particular reference to the influences of works at the Tweed River entrance.

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Background

The coastline of the southern Gold Coast region has experienced many changes over the last century. These changes have been related to complex natural coastal processes, and the interaction of these process with works such as training walls, groynes, beach replenishment and a system to mechanically move (bypass) sand across the entrance to the Tweed River.

The beaches, dunes and nearshore waters in the region are valuable assets used by local residents and visitors alike for many recreational activities. They also form an important buffer zone between the widely varying conditions of the open ocean and the land behind. The state of the beach at any and all times is therefore very important, as is recognising that they are subject to both gradual and rapid changes associated with erosion and conversely the build-up (accretion) of sand.

This document summarises the findings of a detailed study which assessed the historical and potential future changes to the beaches of the area with a focus on the region around Currumbin and the influences related to works at the Tweed River entrance. An understanding and consideration of matters that may affect the future state and use of the beaches is important for ongoing management of the coastline. In particular, the study has assessed if and how observed changes at the southern end of the Gold Coast over recent years may move northwards and alter the characteristics of the beaches in the Currumbin area.

Overview of Coastal Processes and Influences

Critical to the assessment is knowledge of how sand moves together with how and why the beaches respond to natural events and human influences. The action of winds, waves, currents and changing water levels all combine to constantly move the sand on our beaches and in the zone close to shore. This includes a gradual movement along the coast in either direction depending on the conditions at the time. With the dominant winds and waves in this region being from the south-east, the resulting balance is an overall net movement of sand along the coast towards the north.

In addition to the gradual alongshore movement of sand, rapid changes can occur during extreme events such as cyclones and storms when large waves combined with higher than normal water levels can result in sand being eroded quickly from the upper beach and deposited in offshore bars. The sand then moves gradually onshore and along the coast again under subsequent calmer conditions.

Natural features such as rocky headlands and river/creek entrances as well as man-made works including the building of structures and the mechanical shifting of sand, also have controlling influences on the movement of sand. Changes in the patterns of sand movement, either natural or artificial, can result in the beaches and nearshore areas eroding or conversely building up thereby shaping the coastline and affecting the associated recreational values and buffer zone capacity.

Key examples of influences in the study area include severe erosion during cyclone events, and the construction of training walls and groynes across the beach which have trapped the sand moving along the coast causing a build-up on the southern side with corresponding erosion on the northern side.

Assessments Undertaken

The history of events and works in the area has led to numerous investigations, studies and reports being undertaken supported by extensive data collection since around 1970. These activities have helped to provide an understanding of the natural processes and the consequences of works undertaken as well as to inform the design of further works and agreements surrounding management of the coastline.

With gradual changes still being observed along the southern Gold Coast beaches, uncertainties remained as to how the beach at Currumbin might be influenced and respond in the longer term. Further analyses have been undertaken as part of this study to assist the understanding and allow the likely future behaviour of Currumbin beach to be determined. These have included:

- Analysis of beach profile surveys to quantify historical changes in the volume of sand along the coastline over time in response to natural processes as well as the numerous works in the area;
- Preparation of a conceptual model of the sediment budget that links the observed changes with the processes and works, and allowed variations in the natural rate of sand transport along the coast and over time to be derived; and
- Development of a numerical model which simulates the evolution the shoreline over long periods of time to help understand the observed historical changes and derive a prognosis for likely future changes along the coast resulting from past and potential future events and works.

Broad Historical Overview

The shoreline changes that have been observed and the potential for future changes in the southern Gold Coast region are in response to a mix of:

- natural processes including gradual evolution over a long period of time and short-term changes associated with extreme events such as cyclones; together with
- the influences human activities superimposed on top of these natural processes.

In its natural state, the shoreline has evolved over geological time frames under the influences of the prevailing wave climate and major sea level changes. Variations in the rate of the net northward movement of sand along the coast has resulted in areas of sand accumulation and seaward growth of the shoreline while other areas have eroded. The natural entrance to the Tweed River was also shallow and subject to constant change under the prevailing conditions making navigation difficult.

Historical settlement along the southern Gold Coast included developments close to the beach within the active dune system where natural fluctuations occur. As such, they became erosion hot spots vulnerable to storm event driven erosion cycles as well as any longer-term trends of shoreline recession.

The first human intervention which influenced the processes was the construction of the initial Tweed River entrance training walls around 1900 which stabilised the mouth location against ‘North Head’. While these walls were only short, they trapped some of the northward movement of sand along the coast resulting in the build-up of sand along Letitia Spit to the south and the likely loss of sand from the southern Gold Coast beaches.

Erosion threatened development in various locations along the southern Gold Coast in the first half of the 20th Century through the influences of storm events, the initial Tweed River training walls and the direct removal of sand to fill swamp land behind for further development. This erosion became much worse following the extension of the Tweed River training walls in 1962 with an associated greater capacity to trap sand coupled with a series of cyclones in the late 1960's / early 1970's. In response, numerous hard structural works including seawalls and groynes were constructed along the southern Gold Coast at that time to protect development and to manage the shoreline.

Further measures to manage ongoing erosion including works at the Tweed River entrance have since been carried out with various initial and ongoing effects as described below.

Currumbin Context

Currumbin beach is located approximately 8km north of Point Danger and the New South Wales – Queensland border and is often considered as the most northern extent of the southern Gold Coast beach system. Historical development of the esplanade road occurred within the active beach/dune system. Consequently, this section of coastline has been particularly vulnerable to storm erosion events, such as those that occurred in 1936 and 1954, as well as any longer-term influences.

In its natural state, the alignment of the shoreline was governed by Currumbin Rock and headland and the constantly changing entrance to Currumbin Creek at the northern end, and to a lesser extent by Flat Rock and Elephant Rock to the south. Throughout the early to mid-20th century, the beach at Currumbin was continually eroded back to the seawall protecting the esplanade road, which had been constructed further seaward than the natural dune alignment. Waves and sand passed through the gap between Currumbin Rock and the mainland.

While not directly influenced by the loss of sand attributed to the Tweed River training walls, the ongoing threat of erosion to the beachfront development, particularly during the events of the late 1960's / early 1970's, was the driver for construction of a rock groyne in 1973 connecting Currumbin headland to Currumbin Rock. The resulting change in sand transport patterns led to a substantial build-up of sand along Currumbin beach and in the area immediately to north of the creek entrance (South Palm Beach). It was recognised that this would also cause erosion of the beaches further to the north and the initial intention was for the beach to be nourished with additional sand in conjunction with the groyne construction to offset that erosion. However, nourishment did not proceed initially, and it is likely that Palm Beach and Burleigh were adversely affected by erosion.

A northern training wall was also added to Currumbin Creek entrance in 1981 to stabilise its location. However, infilling continues with sand being transported in to the entrance by wave and tidal action. Annual dredging of the creek is now undertaken to provide beach nourishment of southern Palm Beach. In the initial years this was aimed at countering the erosion caused by the groyne construction, but the volume was never sufficient enough to offset the quantity of sand accumulated along the beach at Currumbin.

Since construction of the Currumbin Rock groyne, Currumbin beach has been relatively stable and while the beaches further to the south have been heavily modified by coastal works, no major changes have been observed at Currumbin. Given that coastal effects generally move along the coast towards the north, it is important to understand the future prognosis for the beach at Currumbin considering the natural processes combined with the interventions that have occurred to the south.

Influence of Tweed River Entrance Works

Many of the changes to the shoreline and beaches in the southern Gold Coast region have been related to the construction of the Tweed River entrance training walls and subsequent works to manage the erosion that they caused to the north. Initial responses to the erosion included the construction of seawalls to prevent further recession of the shoreline and groynes to assist in restoring and maintaining sand on the beaches. Despite the massive volume of the erosion on the southern Gold Coast, it had extended only to about Bilinga by 1983, with no evidence that it had affected Currumbin 20 years after the Tweed River training walls were extended.

With the training walls continuing to trap sand and the southern Gold Coast beaches continuing to erode, an alternative management strategy was adopted in the mid 1980's. The Gold Coast City Council and the Queensland Government embarked on a major programme to nourish the eroded areas with additional sand brought into the beach system from inactive sources offshore in deep water. This mass nourishment restored the beaches and the nearshore region primarily from North Kirra to Bilinga and substantially offset the losses attributed to the construction of the Tweed River training walls by that time.

However, the effects of the training walls on sand movements were ongoing as were navigation issues for the Tweed River entrance. In recognition of these factors, the Queensland and New South Wales state governments reached agreement in the early 1990's to implement a sand bypassing project. The purpose of the project was to mechanically move sand across the Tweed River entrance to ensure delivery of the required supply of sand to Queensland and to maintain adequate navigation through the entrance.

The bypassing works began in the mid 1990's with sand being dredged from the entrance region and placed in the eroded areas to the north. The second and ongoing stage of the programme commenced in 2001 incorporating a trestle system which pumps sand from the southern side of the entrance to various beach locations to the north. Pumping through the trestle system and periodic dredging continued at a higher than normal rate for the first 6 years in line with an agreement between the states to make up the deficit remaining in the Gold Coast beach system from the effects of the extended training walls.

This initial bypassing at a higher rate caused the shoreline to the south of the entrance to recede as planned and also resulted in a substantial build-up of sand along the southern Gold Coast beaches. Together with the benefit of the initial beach nourishment in the late 1980s, the volume of sand on the beaches by 2009 was now greater than before the training walls were extended, particularly in the North Kirra embayment.

This initial sand build up was largely due to unseasonably calm ocean conditions, particularly in regards to cyclone swell events from the North east. A reduced rate of pumping and limited dredging over the last decade has seen a gradual spreading of that additional sand under natural processes. The analyses show general increases in the volume of sand on the beaches extending northwards from the Kirra embayment to Tugun but not as far as Currumbin Rock. The beach at Currumbin has been stable and generally in good condition since construction of the Currumbin Rock groyne and has not been influenced to date by the Tweed River entrance works.

Future Evolutionary Trends

With the expected trend of sand dispersing to the north being evident, numerical modelling of the processes and how the shoreline can be expected to behave has been undertaken to better understand the likely

magnitude and extent of future changes. This modelling covers the period from 1900 to 2100 and has helped confirm the observed historical trends discussed above as well as allow the determination of the likely evolution of the shoreline into the future (based on certain assumptions).

The model reproduces the historical erosion of the southern Gold Coast beaches associated with the Tweed River entrance training walls and the build-up of sand to the south of the Currumbin Rock groyne. It also reflects the substantial increase in volume of sand on the southern Gold Coast beaches, particularly in the North Kirra region, through the initial period of sand bypassing at a higher rate as well as the subsequent spreading of that sand after the rate was reduced.

In looking forward, the model predicts that the substantial volume of sand, which predominantly accumulated in the Kirra / Bilinga embayment since 2001, will continue to be dispersed gradually northwards. This will have the effect that Currumbin and Palm Beach will experience an increased supply of sand.

At Currumbin, the magnitude of changes related to this increased supply are expected to be quite subtle and certainly much smaller than the change that was seen with the construction of the Currumbin Rock groyne in 1973. Importantly, both the rate and final magnitude of increases in the volume of sand are expected to be much lower for the beaches to the north as the extra sand gradually spreads along the shoreline. Unlike the beaches from Snapper to North Kirra, the beaches further north are not expected to experience a large spike in the volume of sand followed by a substantial reduction. Instead it is expected that Bilinga North and Currumbin beach volumes will continue to trend upwards and gradually approach a new more accreted state in balance with the increased supply.

The entrance to Currumbin Creek will continue to experience natural infilling, with a substantial year to year variability in volumes and spatial distributions necessitating ongoing maintenance works. The re-instatement of a higher supply of sand to Palm Beach is also expected to contribute a subtle but positive increase in the volume of sand on the beaches. However, without additional intervention, Palm Beach will most likely continue to remain vulnerable to short-term storm erosion events due to the insufficient sand supply buffer in front of the A-line seawall defences.

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