"TWEED SAND BYPASSING CONTINUES TO SUPPORT THE VERY ESSENCE OF THE TWEED AND SOUTHERN GOLD COAST LIFESTYLE – SANDY BEACHES, A SAFE AND NAVIGABLE RIVER ENTRANCE AND WORLD-FAMOUS SURF BREAKS."

Sand magazine by Tweed Sand Bypassing.

04

Tweed Sand Bypassing

PART B: ENVIRONMENTAL CHANGE AND MANAGEMENT

KEY INQUIRY QUESTIONS

HOW DOES TWEED SAND BYPASSING (TSB) ATTEMPT TO MIMIC THE NATURAL PROCESSES THAT FORM AND TRANSFORM TWEED AND GOLD COAST BEACHES OVER TIME? AN

WHAT WOULD BE THE ENVIRONMENTAL, SOCIAL AND ECONOMIC IMPACTS OF ENDING TSB? EV

PART 4B CONTENTS

HISTORICAL CHALLENGES AND RESPONSES

Tweed River

The Tweed River entrance was first used in the 1880s to open up the Northern Rivers region to trade and settlement. Navigation of the Tweed River has historically been very dangerous with the sand shoals around the entrance constantly moving and changing in response to the varying wave climate. During the early years of use the Tweed River entrance claimed many lives as boats capsized or were shipwrecked while trying to gain access to the river.

To control the sand shoal movement and improve navigation, training walls were constructed in the late 1890s, and then extended seaward by approximately 380 metres in the early 1960s. While improving navigation temporarily, the problem with the extension of the training walls was that the natural longshore drift that was travelling northwards along Letitia Spit was now being trapped behind the southern wall. This meant that the sand was unable to cross the Tweed River entrance bar and nourish the southern Gold Coast beaches in Queensland.

Once the sand had built up to the end of the southern wall it began flowing around and into the Tweed River entrance, recreating the bar that had historically been such a navigational hazard.

Figure 1: Duranbah in the late 1950s before the Tweed River entrance training walls were extended. Source: Tweed Sand Bypassing

Figure 2: Aerial photograph of the TSB project area in 1956, before the Tweed River entrance training walls were extended. Source: Tweed Sand Bypassing

Southern Gold Coast beaches

Southern Gold Coast beaches such as Coolangatta and Kirra are very important for the tourism industry, are aesthetically attractive and used for recreational activities including swimming and surfing. The tourism industry relies on these beaches being sandy to attract people to stay and inject money into the economy. Sandy beaches provide a natural buffer that can prevent extreme erosion threatening buildings, roads and other infrastructure built close to the shoreline. When the sand supply disappears, infrastructure can be threatened or impacted.

In the 1930s and 1950s before the training walls were extended there was periodic erosion from storm and cyclone events, but beaches recovered naturally through deposition from wave action and currents. The extended training walls blocked the natural sand flow leaving very little sand available to replenish the beaches after storm events in the 1960s and 1970s and continued erosion from through the late 1970s to the 1990s.

Figure 4: Aerial photograph of the Tweed Sand Bypassing project beaches in 1979. Source: Tweed Sand Bypassing

Figure 3: Eroded Kirra Beach in the late 1960s. Source: Tweed Sand Bypassing

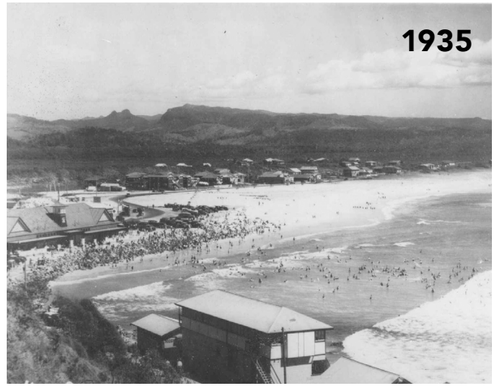
After a series of cyclones and east coast lows from 1967 through to the mid-1970s, seawalls were constructed along the coastline and beaches renourished using sand dredged from behind the southern training wall where it had accumulated. In total, 760,000 cubic metres of sand was dredged and deposited onto Kirra Beach in 1974–1975 at a cost of approximately 5 million dollars (corrected for 2020), however this was not seen as being a permanent solution to the problem.

Kirra Beach coastal management strategies

Kirra Beach is located on the southern Gold Coast, bordered by Kirra Point to the south and the Coolangatta Creek outfall to the north. Over time, human interventions such as the influence of man-made coastal structures have modified natural processes, changing the way the beach looks.

In the 1930s and 1940s seawalls were built at Kirra Beach to protect it from storm events. In the 1960s the Tweed River entrance training walls were extended, interrupting sand supply to the southern Gold Coast beaches; as a result Kirra Beach was badly eroded. In the 1970s two groynes were built and sand was added to the beach (sand nourishment) to reduce erosion. Figure 5 explains different coastal management strategies from 1935 to 2018.

Figure 5: Kirra Beach coastal management strategies (1935–2018).



1930s. Kirra Beach and foredune was approximately 200 metres wide.

1960s. The Tweed River training walls were extended between 1962 and 1965 to maintain a navigable entrance. During 1967 the Gold Coast experienced several cyclones and the erosion effects due to the disruption in longshore sand supply became apparent.

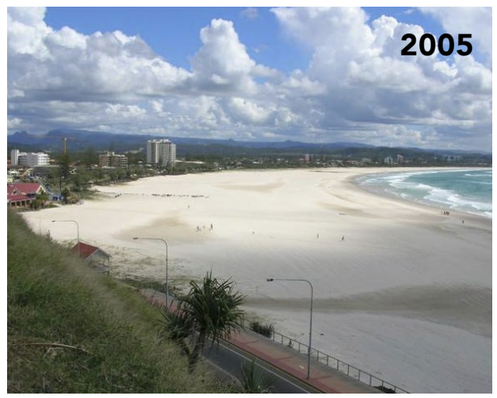
1990s. To offset severe erosion, the initial stages of TSB provided 3.6 million cubic metres of sand between Kirra and Tugun.

1940s. There were a series of catastrophic storms, and during this time Kirra and other beaches of the southern Gold Coast were severely eroded. Seawalls were built to protect infrastructure.

1950s. Kirra had recovered from storm events in the previous decade and was in an accreted condition.

1970s. In 1972 the Kirra Point Groyne was built. A seawall was built in 1973 and Miles Street Groyne in 1974. In 1975 a total of 760,000 cubic metres of sand was pumped from the lower reaches of the Tweed River to nourish Kirra.

1980s. Erosion at Kirra reaches a peak in 1982 and rock exposure at Kirra headland and Kirra Reef was greatest during this period. In 1985 a further 315,000 cubic metres of sand was placed at North Kirra Beach.



2000s. The Tweed River Entrance Sand Bypassing Act was passed in 1995 in NSW, and 1998 in Queensland. The permanent bypassing system was officially commissioned in 2001.

2010s. Since 2009 Kirra Beach has significantly reduced in width, and naturally fluctuates due to seasonal change.

STUDENT ACTIVITIES

KN KNOW
UN UNDERSTAND
AP APPLY
AN ANALYSE
EV EVALUATE
CR CREATE

1. Identify the worldview relevant to the building of the Tweed River training walls. AP

2. Why did strategies implemented to improve navigation at the Tweed River entrance have severe consequences for beaches in Queensland? AN UN

3. "Surf + Sand = success for Coolangatta". How is this statement true for southern Gold Coast beaches? AN

4. Refer to Figure 6. UN AN CR

   Create a 3 column table. Label the columns Time, Change and cause of change. Summarise changes to Kirra Beach over time.

5. Use your understanding of coastal processes to create a 'chain of reasoning'. UN AP CR

   Explain the impact of building training walls on any river flowing into a sandy coast on the east coast of Australia. KN UN AP CR

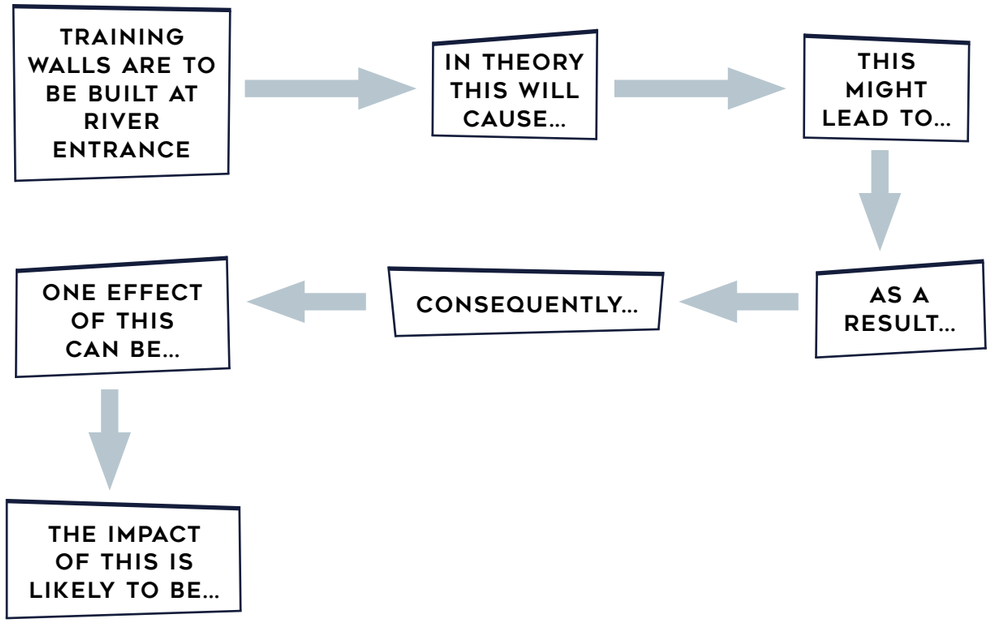


Figure 6: Chain of reasoning.

TWEED SAND BYPASSING

A solution that would replenish the natural coastal sand drift to southern Gold Coast beaches and maintain a safe entrance to the Tweed River was needed. A decision to build a permanent jetty mounted-pumping system supported by intermittent dredging at the river entrance was decided upon in the 1990s and Tweed Sand Bypassing commenced in 2001.

The Tweed Sand Bypassing system

Tweed Sand Bypassing consists of a sand pumping jetty and floating dredge, and was designed to collect the sand that is naturally transported northwards along Letitia Spit before it moves into the Tweed River entrance and restricts boating access. Figure 9 and 10.

The jetty

The jetty is 450 metres long and supports 10 submersible jet pumps that sit below the sea bed and collect the sand that is naturally transported towards them. The pumps do not 'suck' sand from the ocean bed, or out of the Tweed River, but collects sand that is naturally transported to the jetty through the process of longshore drift. This sand is then pumped under the Tweed River entrance and is deposited at one of the outlets before being naturally moved by waves and currents to nourish the southern Gold Coast beaches. Figure 7a and 7b.

There are four outlets. Snapper Rocks East and Snapper Rocks West are permanently installed, while Duranbah and Kirra are only temporary installations and are used when they are needed.

- Snapper Rocks East (permanently installed and used most of the time)
- Snapper Rocks West (permanently installed and used occasionally)
- Duranbah (temporarily installed twice a year to add sand to Duranbah)
- Kirra (temporarily installed. It has not been used since 2003 but may be in the future).

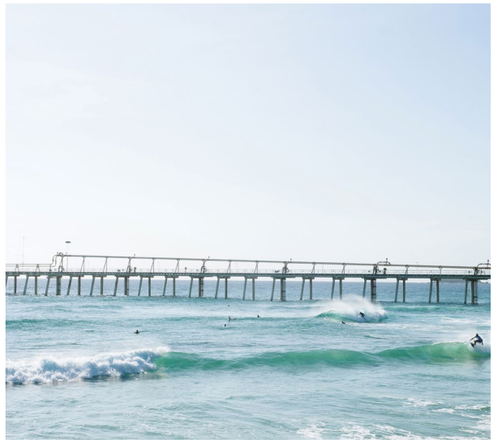


Figure 7a: Tweed Sand Bypassing sand pumping jetty at Letitia Spit, northern NSW. Source: Tweed Sand Bypassing

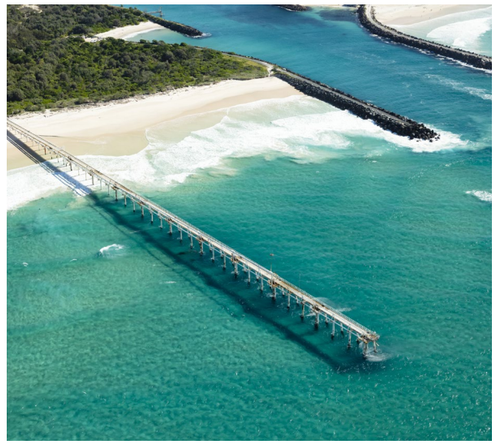


Figure 7b: Oblique photograph of the Tweed Sand Bypassing sand pumping jetty at Letitia Spit, northern NSW. Source: Tweed Sand Bypassing

Floating dredge

The jetty is unable to collect all of the sand that is transported along Letitia Spit and some of this sand naturally bypasses the jetty and moves into the Tweed River entrance. This process is more pronounced during storm events when large waves and strong currents are able to transport sand in water that is further offshore (and deeper) than usual. Figure 8.

Figure 8: Tweed Sand Bypassing dredge, removing sand from the Tweed River entrance. Source: Tweed Sand Bypassing

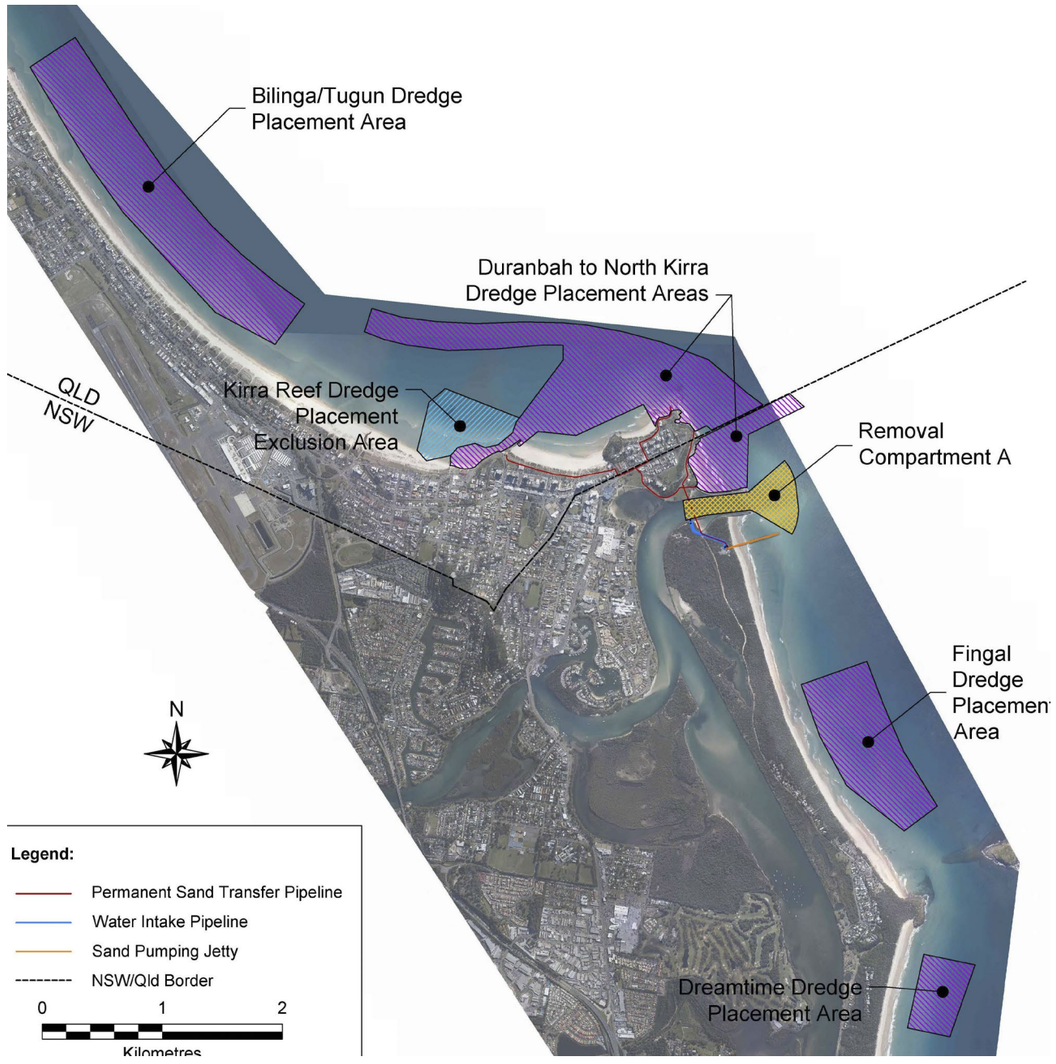


Figure 9: Map showing the location of the Sand Pumping infrastructure and dredge removal and placement areas. Source: Tweed Sand Bypassing

Some of the sand that ends up in the Tweed River entrance moves naturally across the Tweed bar and forms sand shoals offshore of Duranbah and Point Danger. Over time, more and more sand will accumulate on the bar and when a certain navigation threshold is reached the entrance is dredged.

Sand is delivered offshore of the project beaches, including beaches south of the jetty in New South Wales. This is done to ensure that sand is spread evenly throughout the whole project area. The volumes delivered to each placement area will vary for each dredging campaign.

Figure 10: Map showing the sand pumping infrastructure. Source: Tweed Sand Bypassing

The project timeline

Tweed Sand Bypassing (formally known as The Tweed River Entrance Sand Bypassing Project) was initiated by the NSW and Queensland governments. The governments acknowledged that the problem affected both states and were willing to work together towards a solution.

Early 1990s – suggestions for a sand bypass facility to collect sand on the southern side of the Tweed River, pump it under the river and deliver the sand to the southern Gold Coast. This followed the success of a system on the northern Gold Coast in 1986 to bypass sand from the Spit under the Gold Coast Seaway to South Stradbroke Island.

1995 NSW legislation – *Tweed River Entrance Sand Bypassing Act 1995 No 55* and an Environmental Impact Statement (EIS) to evaluate if the installation of a bypassing system would be of benefit. The EIS investigated potential impacts and highlighted areas of concern about installing the system.

1995 to 1998 – Stage 1: 3 million cubic metres of sand dredged from the Tweed River entrance and deposited on the southern Gold Coast at Rainbow Bay, Greenmount, Coolangatta, Kirra and North Kirra. This addressed the urgent need to renourish depleted Gold Coast beaches.

1998 Queensland legislation – *Tweed River Entrance Sand Bypassing Project Agreement Act 1998.*

1998 – TSB approval by the NSW Department of Planning subject to a wide range of conditions for the design, construction and operation of the Project. TSB had approval to go ahead with the bypass but would need to closely monitor the impacts to prevent any negative affects to the environment and local people.

2000 – Stage 2: the installation of a permanent bypassing system in 2000 by private company McConnell Dowell and the formation of the Tweed River Entrance Sand Bypassing Company to construct and operate the system.

2001 – Sand bypassing commenced.

2001–2024 – Sophisticated monitoring and ongoing community consultation.

2019–2024 – *TSB Transition Project* to develop a new operating model to be implemented after 2024.

2024 – The Tweed Sand Bypassing (TSB) Concession Agreement (the contract between the governments and the Operator) will expire and future plans are to be developed.

STUDENT ACTIVITIES

KN KNOW
UN UNDERSTAND
AP APPLY
AN ANALYSE
EV EVALUATE
CR CREATE

1. Create a timeline for the Tweed Sand Bypassing project. UN AP

2. It is often stated that TSB moves sand 'as nature intended'. What do you think this means? UN

3. Examine Figures 9 and 10.

   Work with a partner to develop two optional 'travel journeys' for a grain of sand travelling northwards along Letitia Spit towards the jetty. The sand must travel through TSB pipelines and the final destination will be North Kirra Beach. Natural processes should be referred to in your story. KN UN AP AN CR

4. To expand your knowledge of the TSB and to demonstrate your understanding:

   i. work in pairs to complete the See Saw activity (Activity Worksheet 3) while watching the TSB video on the Tweed Sand Bypassing website. KN UN

   ii. you have 1 minute to explain Tweed Sand Bypassing to a non-geographer. List 5 key ideas and 3 images you would use to assist you. AN EV CR

   iii. work in pairs to present your explanation, provide peer feedback and make any changes to improve your explanation. AN EV CR

5. Is the TSB project based on a different worldview to the construction of the Tweed River training walls? Explain. UN EV

6. Explain the large areas of sand placement shown in Figure 9 compared to the small area of sand removal. UN AN

Mimicking nature

In the early years, TSB deliberately pumped higher volumes of sand than would have been delivered naturally. This was to provide much needed sand to southern Gold Coast beaches that had been badly eroded over many years. The additional sand caused very wide beaches and created a long continuous bank of sand from Snapper Rocks to Kirra. This was known as the Superbank. Since 2005 the project has been pumping quantities of sand consistent with the natural longshore drift. Since 2008, the initial quantity of sand which had accumulated at Kirra has dispersed.

TSB is a year-round operation to transport the sand nature brings along the coast. This means the amount of sand pumped depends on environmental conditions. Calm conditions usually mean there is little or no sand to pump, while in higher wave conditions pumping may be continuous because there is a lot of sand to move. The system operates mostly at night to take advantage of the cheaper 'off peak' electricity prices provided by the electricity supplier. There is no 'down period' or 'pumping season' in the operation. Figure 11.

Nature is unpredictable: the Superbank

The Superbank was born out of sand pumped to the Snapper Rocks East outlet that was shaped by waves and currents into a shore-parallel beach bar extending from Snapper Rocks all the way through to Kirra. The Snapper Rocks surf break attracts surfers from across the world due to its reputation as one of the most consistent surf breaks in Australia. Today, surfing conditions at Snapper Rocks are more variable and depend on the natural conditions.

	m^3
2001	575,869
2002	721,364
2003	787,026
2004	496,367
2005	724,931
2006	552,284
2007	562,247
2008	585,809
2009	409,232
2010	395,609
2011	518,168
2012	436,092
2013	319,883
2014	465,501
2015	552,682
2016	419,564
2017	405,524
2018	361,247
2019	360,052
2020	81,195
TOTAL	9,546,010

Figure 11: Annual Volumes of sand pumped from NSW to Queensland by TSB. Note: the 2020 volume is sand delivered from January to April.

Figure 12: Excerpt from Sand *magazine. Source: Tweed Sand Bypassing*

Snapper

FROM FICKLE TO FANTASTIC

On any given day, the regular supply of both pumped and natural sand ensures that Snapper is one of the most reliable surf breaks in the country. But this has not always been the case.

Pre 1960s – free flowing

Before the Tweed River training walls were extended in 1962 sand flowed freely across the shallow Tweed bar, moving around Point Danger in large shoals. "Snapper Rocks was a fickle wave, Rainbow Bay was traditionally a longboard wave and Greenmount Point was a very separate longboard wave on the point, right on the rocks. They were three separate breaks," says Peter Turner, long-term Gold Coast resident and member of the Project's Advisory Committee.

1960s to 1990s – obstacles and erosion

The effects of extending the Tweed River entrance walls in 1962 weren't fully evident until five years later when the Gold Coast experienced several cyclones in short succession. The next 30 years saw an ongoing battle with erosion with seawalls built at Coolangatta and Kirra, groynes at both Kirra Point and Miles Street, and several large attempts at beach nourishment.

During this time Snapper had the occasional great surf break – but you could wait two years for it! Instead, during the 1970s, and particularly 1980s, with Kirra Point groyne and the severely eroded profile and nearshore reef, the real action was at Kirra.

Post 2001 – pumping

Tweed Sand Bypassing commenced in 2001, with the river of sand once again flowing from south of the Tweed River entrance and onto the Southern Gold Coast beaches. The Superbank was born out of sand pumped to the Snapper Rocks East outlet that was then shaped by waves and currents into a shore parallel beach bar extending from Snapper Rocks all the way through to Kirra. Ian Taylor who was the Project Manager at the time describes the impact of the Superbank on the Coolangatta community: "There was a lot of contest – some people loved it – I had people ringing me from Honolulu saying 'Is the Superbank working?' because they wanted to fly out and have a wave, but many of the local surfers were disappointed. It was about change – the Superbank came along as nature's response to a huge injection of sand after such a long period of low sand and changed how the area operated."

Today

The catch-up quantity of sand has been shifted north and Tweed Sand Bypassing only delivers the natural supply. The sand supply from both natural offshore drift and bypassed sand now experience a more natural variance.

"What we've gained from the sand bypass is good beaches; plenty of sand and an incredibly consistent surfing wave," says Peter. And as for Kirra –now that the natural supply of sand has been reinstated it will never break as it did in the 1980s when heavily eroded. But with the right swell and seasonal erosion around the point, Kirra will certainly find its way back on the surfing map.

"The river walls at the Tweed, the groyne at Kirra, the sand bypass, were about creating better beaches, saving foreshore infrastructure, and better navigation. Improving surf quality has been a 'happy accident."

Peter Turner

"When the Superbank was in, it was a wonderful wave but about 50 good surfers could monopolise it, and they don't make many mistakes. The less proficient surfers didn't get a look in. The good guys dominated it for many years — it was great surf for some, but for others it was unobtainable".

Peter Turner, TSB Advisory Committee member.

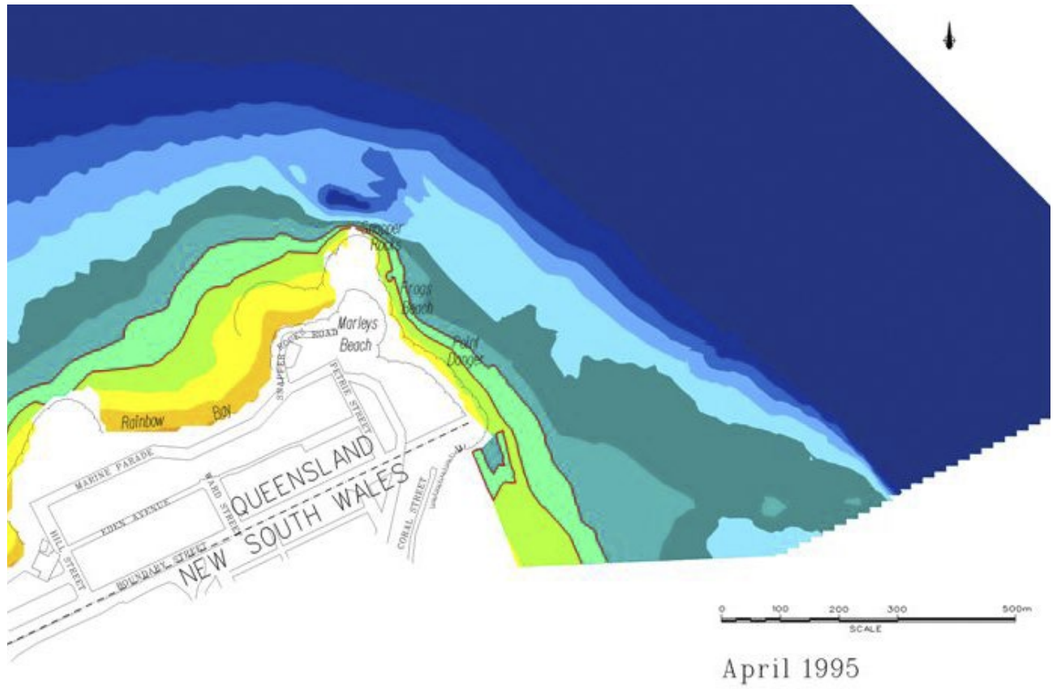


Figure 13a: April 1995 condition showing inconsistent Snapper Rocks sand bank. This bathymetry does not produce high-quality surfing conditions. Source: Tweed Sand Bypassing

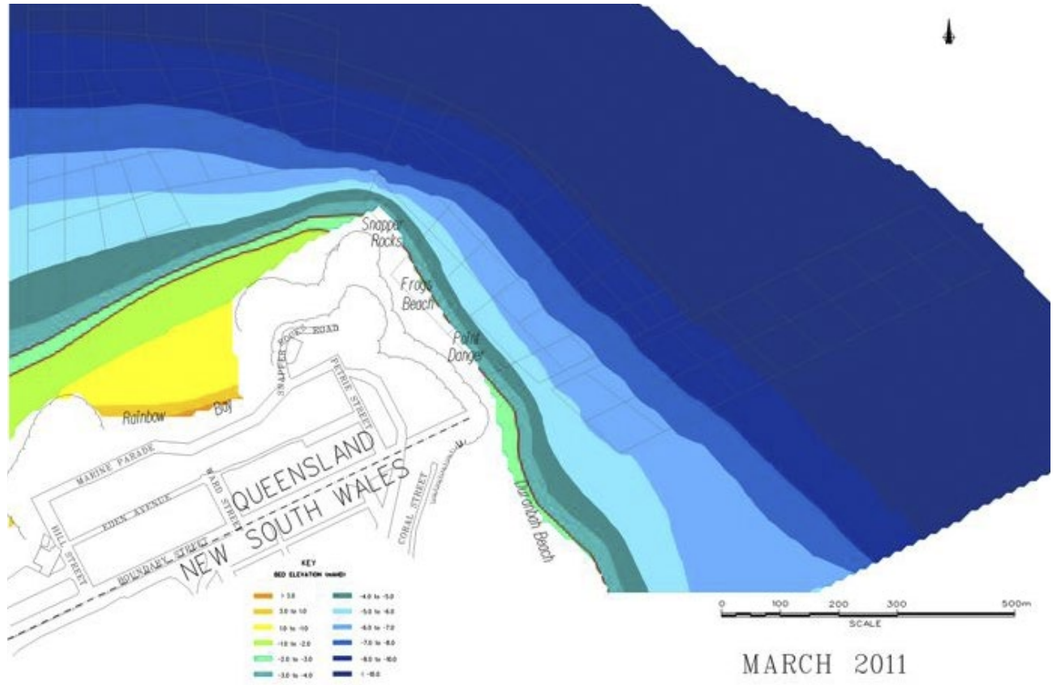


Figure 13b: March 2011 condition showing consistent Snapper Rocks sandbank. This bathymetry does produce high-quality surfing conditions. Source: Tweed Sand Bypassing

STUDENT ACTIVITIES

KN KNOW
UN UNDERSTAND
AP APPLY
AN ANALYSE
EV EVALUATE
CR CREATE

1. Refer to figure 11. UN AP AN CR
   i. Graph the statistics in a column graph. Use a digital graphing tool such as Excel.
   ii. Analyse the changes to sand pumped through the system. If the system mimics nature, describe what natural changes are occurring to make the volumes of pumped sand increase and decrease. Refer to specific years in your answer.

2. Do you think coastal processes are truly unpredictable? Give a reason for your answer. EV

STUDENT ACTIVITIES

KN KNOW
UN UNDERSTAND
AP APPLY
AN ANALYSE
EV EVALUATE
CR CREATE

Snapper Rocks surfing sandbank AP AN

1. Refer to Figures 13a and 13b.
   i. Copy the images onto the centre of a page or onto a digital document.
   ii. Annotate the images to identify features that have changed between 1995 and 2011.
   iii. Use Google Earth to grab a screen capture of the same section of coast today. Identify changes that have occurred since 2011.

2. Watch *this video*. Do you notice any incorrect information? AN EV

3. Watch a video of surfers at Snapper Rocks. *Here is an example*. Describe what you see. AP

4. Why was the Superbank considered a 'happy accident'? Which stakeholders were happy? EV

5. Find out more about the Superbank through geographical inquiry. AP CR
   - Start with an inquiry question.
   - Conduct your research.
   - Analyse your findings and draw a conclusion or answer to your question.
   - Create a digital presentation to communicate your findings such as a StoryMap.

"You can't precisely manage nature, but the Tweed Sand Bypassing Project hasn't given up — we're constantly gathering knowledge and refining, always trying to make it better".

Ian Taylor — TSB Project Manager 2002—2010

ONGOING MONITORING AND ADAPTIVE MANAGEMENT

Coastal monitoring

The one constant in a coastal environment is that it's always changing. Tweed Sand Bypassing has an extensive coastal monitoring program that assesses the environmental change along the beaches, Tweed River Estuary and offshore reefs.

There are two main reasons for ongoing monitoring:

- to meet conditions imposed by the government approval to monitor impacts
- to learn as much as possible about the coastal environment in which the project operates to make sure that TSB is always innovating and improving to provide the best possible outcome.

To make sure that the impacts of TSB were managed, an environmental management system was developed and implemented.

Examples of monitoring by the NSW and Queensland Governments include:

- monthly *environmental monitoring summaries* for the project area between the Tweed River entrance (NSW) and Kirra (Queensland)
- quarterly *beach profile surveys* from Letitia Spit (NSW) to Kirra (Queensland)
- annual *beach profile surveys* undertaken annually out to 20 metres water depth between Fingal (NSW) and Currumbin (Queensland)
- regular *aerial photography* of the river entrance and the beaches
- continuous *wave monitoring* by the Tweed and Gold Coast wave buoys
- continuous *beach condition monitoring* using a network of video cameras.

Geographical tools and methods

The TSB project team collaborate with a range of experts to:

- collect field data such as aerial photographs and bathymetry
- process the information through the use of GIS and computer models
- communicate the results.

A variety of geographical tools is used to collect primary data to monitor the factors changing coastal sediment (sand) conditions, Table 1 Figure 14 and 15. The quantitative and qualitative data collected is used to create visual material such as videos, diagrams, graphs, maps and infographics for:

- reports and presentations
- the TSB website and *Sand* magazine
- the TSB app
- Instagram
- creating ESRI storymaps
- analysis by the TSB Project team for adaptive management.

Table 1: Geographical tools and TSB monitoring

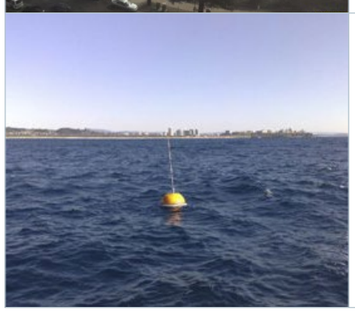
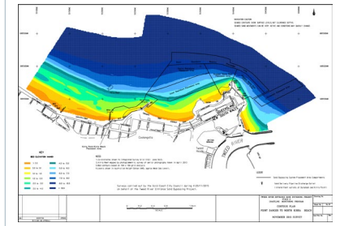
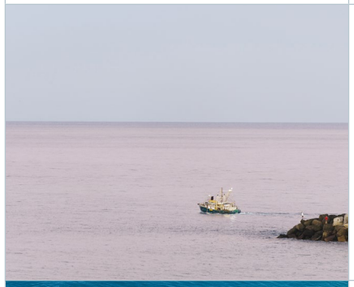
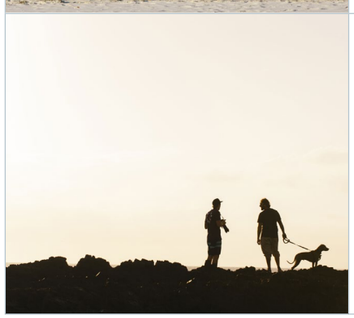
PRIMARY DATA SOURCES	GATHERING PRIMARY DATA: FIELDWORK	PURPOSE
	1. Vertical aerial photographs of the project area (Fingal–Currumbin) are taken from an aeroplane at a fixed height. This has historically occurred in autumn and spring.	Aerial photographs are georeferenced and used in GIS to carry out spatial analysis. Changes to beaches, offshore sand banks and reef exposure can be measured and analysed
	2. Oblique photographs taken from helicopters every 3 months.	Series of photographs are used to: ◗ make visual comparisons of change over time ◗ identify and annotate potential causes of change such as storms and seasonal wave conditions.
	3. Ground-level beach photographs taken ◗ from 5 locations at the main project area beaches every few months. **or** ◗ by community members at the Gold Coast CoastSnap station at Kirra Hill (City of Gold Coast)	
	4. ARGUS camera network – a series of cameras on tall buildings in Coolangatta take photos every minute of Kirra, Coolangatta, Greenmount and Rainbow Bay.	Images are merged using computer programs and the location of the shoreline for each beach is determined. The images are used to make time-lapse videos which are used to examine and communicate beach change over time.
	5. Wave monitoring using a wave rider buoy in the ocean off Fingal to record wave height, period and direction.	Computer models use wave data to predict how much sand is moving along Letitia Spit by longshore drift. Wave data is also used to: ◗ interpret changes shown on hydrographic surveys and photographs ◗ create wave roses.

Table 1: Geographical tools and TSB monitoring

PRIMARY DATA SOURCES	GATHERING PRIMARY DATA: FIELDWORK	PURPOSE
	6. Hydrographic surveys collect bathymetry – the depth of the ocean floor – using sonar from a boat or jet-ski.	Computer programs analyse the data to determine the change, over different time scales – by comparing surveys and calculating differences. Maps and diagrams are also produced to visualise changes in the sea floor.
	7. Boat crossing data is collected by Marine Rescue at Point Danger.	The crossing data is graphed over different time scales to determine patterns and trends.
	8. Dredge logs are used to record exactly where TSB sand is being collected and placed.	The data is collated into tables and graphed.
	9. Surf quality – visual records. Qualitative data from observations, surfing photos and videos obtained by or from: ◗ the TSB Project team ◗ sites such as Coastal Watch ◗ the TSB Advisory Committee ◗ the surfing community.	Wave peel analysis is used to determine surf quality at Duranbah Beach.
	10. Community consultation is the primary mechanism of gaining opinion and sentiment about Tweed Sand Bypassing. It includes: ◗ quantitative data collected through online survey ◗ qualitative data collected through questionnaires, interviews and ongoing discussions (particularly with the Advisory Committee).	Feedback from community consultation is used to: ◗ incorporate local coastal processes knowledge when planning for sand delivery ◗ figure out what the information needs of the community are ◗ understand how the community feels about Tweed Sand Bypassing and what improvements can be made (adaptive management).

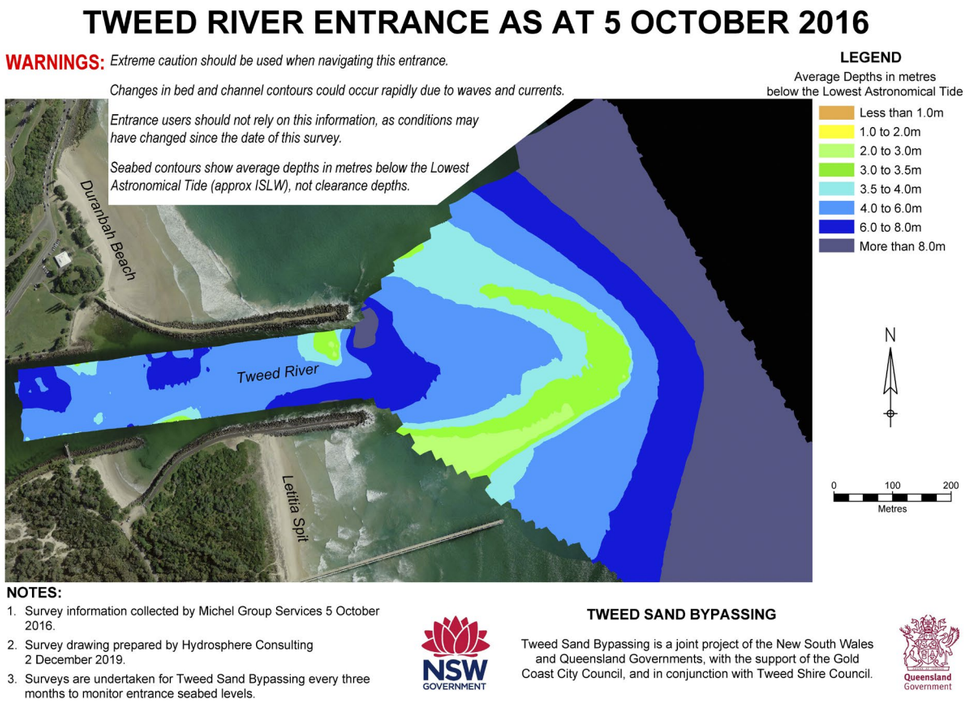


Figure 14a: Tweed River entrance map 5 October 2016

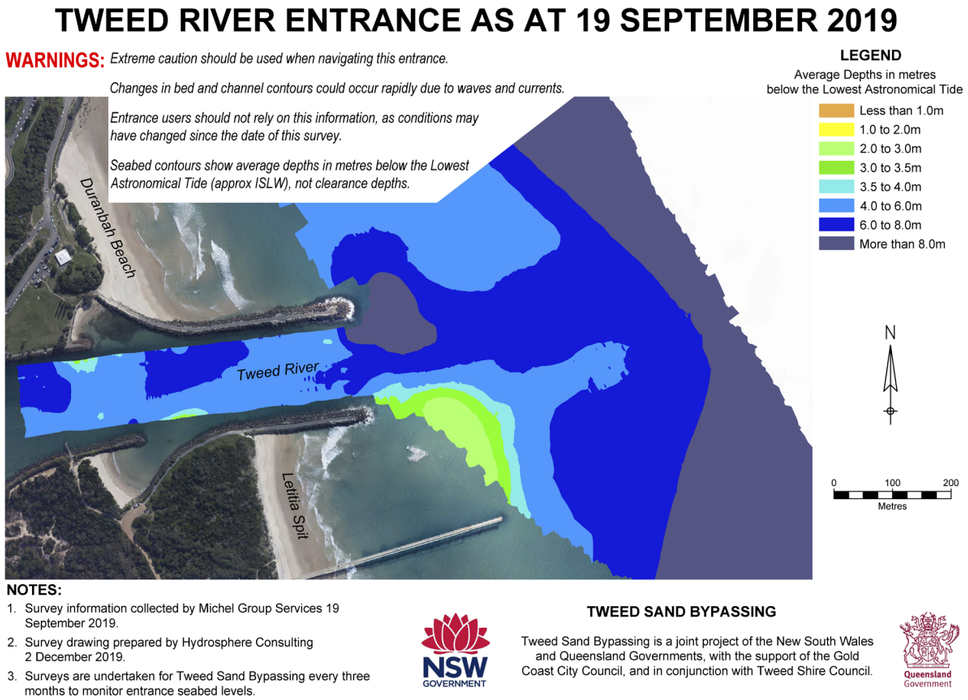


Figure 14b: Tweed River entrance map 19 September 2019

CASE STUDY

ARGUS COASTAL IMAGING SYSTEM

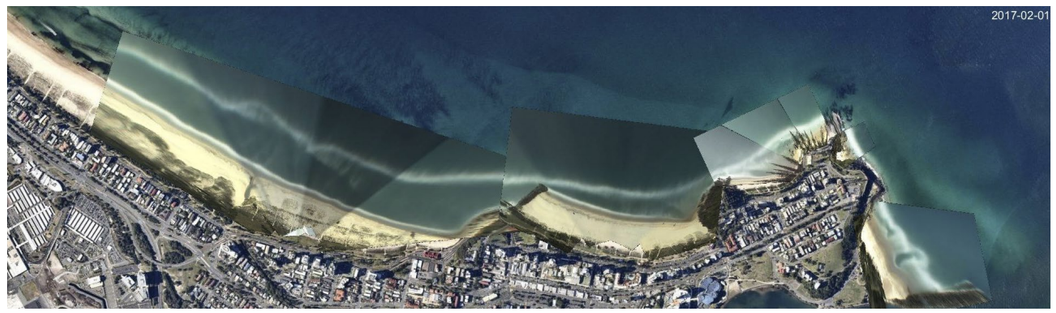
One of the most effective tools that the project has to analyse the way that beaches are constantly changing is the ARGUS coastal imaging system. Click on each image to see time lapse images from some of our cameras during Cyclone Oma, in February 2019. The videos cover 15 days of images from 15 February 2019 to 1 March 2019 and help to show how much sand is moved during a large swell event.

Duranbah Beach. Source: UNSW WRL

Rainbow Bay. Source: UNSW WRL

Coolangatta (looking north). Source: UNSW WRL

Coolangatta (looking south). Source:UNSW WRL



Mega Merge of the project area (Duranbah NSW to Kirra Queensland). Source: UNSW WRL

STUDENT ACTIVITIES

KN KNOW
UN UNDERSTAND
AP APPLY
AN ANALYSE
EV EVALUATE
CR CREATE

1. Use Find it Fix it (Activity Worksheet 4) to test your knowledge and understanding of the Tweed Sand Bypassing.

2. Explain why the TSB project is an example of adaptive management. AN

3. Refer to Table 1. KN UN AN
   i. Categorise the fieldwork data-gathering methods into those collecting quantitative data and those seeking qualitative information.
   ii. Define the following terms – bathymetry, high resolution images, wave peel, georeferenced photographs, wave period. Use each term in a sentence describing a feature of coastal change or management on the Tweed/Gold Coast environment.
   iii. What is the purpose of the map in Figure 14a and 14b?
   iv. What information is needed to create this map? How is that obtained?

4. Refer to the Stimulus Booklet with this resource. Complete all activities using your knowledge and understanding of the Tweed/Gold Coast environment and its functioning. KN UN AP AN

5. Could there be any alternatives to a sand bypass system for keeping the river entrance clear and beaches north of the river entrance nourished? EV

KEY LEARNING

- When human activity interferes with the natural processes of the ocean and coastal zone, problems are almost inevitable.
- The Tweed River training walls interfered with the northwards drift of sand along the coast with consequences for the southern Gold Coast beaches.
- A joint venture between the NSW and Queensland governments led to Tweed Sand Bypassing to restore the natural flow of sediment along the coast to the beaches north of the Tweed River.
- Other management strategies, including dredging, nourishment, sea walls and groynes, are also used to deal with other beach management challenges.
- Monitoring using a range of tools to collect data is an important component of Tweed Sand Bypassing. Tools such as photography, wave buoys and sonar provide qualitative and quantitative data.