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Wallis Lake

Dredging and Disposal Options Assessment



301020-02712

FINAL REPORT (v2)

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Wallis Lake Dredging and Disposal Options Assessment

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PROJECT 301020-02712 - WALLIS LAKE DREDGING AND DISPOSAL OPTIONS REPORT

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1 INTRODUCTION

1.1 Study Area

The Wallis Lake estuary is located in the Great Lakes Local Government Area (LGA). The entrance area (Cape Hawke Harbour) is trained by breakwaters and training walls (dating from the late 1800s), with the towns of Forster and Tuncurry located on either side. The two towns are connected by a bridge which crosses the lower estuary. Prior to construction of the bridge in 1961, vehicle ferries operated between the two towns (Webb McKeown 1999).

There are numerous islands within the lower estuary, with Wallis Island being the largest. The location and extent of shoals between the Wallis Lake entrance and Wallis Island are influenced by tidal and flood flows and the penetration of ocean storm waves into the lower estuary. Construction of the northern breakwater had a significant effect on tidal velocities, ranges and shoaling patterns and the estuary is still in a state of readjustment (PWD 1992). Changes to shoaling patterns and migration of marine tidal deltas into Wallis Lake have the potential to impact on the viability of navigation channels and oyster leases. Various dredging operations have been undertaken, or proposed, over the years to maintain adequate depths for navigation and oyster cultivation (see **Section 1.5**).

WMA (1999) noted that based on historical aerial photography (1937 to 1997) and site inspections carried out as part of the *Wallis Lake Estuary Processes Study*, there appeared to be an accumulation of sand in the channel between Wallis Island and Tonys Island. It was also noted that the marine tidal delta between the islands had extended by approximately 300 m to the south, threatening extensive *Posidonia* seagrass beds. An accumulation of sand on the south-western corner of Hadleys Island was also noted. Erosion of islands within the entrance channel was also evident, particularly just upstream of the Forster–Tuncurry Bridge. Currently erosion of Long Island threatens a public amenities building.

1.2 Study Purpose

The purpose of this Study is to provide Great Lakes Council with a coordinated approach to planning for maintenance dredging of the lower Wallis Lake estuary (see **Figure 1.1**) and disposal of dredged sediment. The focus of this Study is an assessment of dredging requirements for maintenance of navigation depths for recreational boating activities. Information on past dredging to maintain access to oyster leases and for sufficient depths and water flow for oyster cultivation has also been discussed in this report.

The assessment of disposal sites relates mainly to the feasibility of installing a permanent pipeline for pumping dredged marine sands for disposal on Tuncurry Beach (southern end of Nine Mile Beach). Other potential disposal options for dredged material (and delivery methods) have also been discussed.



1.3 Study Area Features

Wallis Lake covers an area of 98.7km², which includes areas mapped as open water, mangrove and saltmarsh (DECCW 2010a). Two main river systems discharge into the lake; the Wallamba River and the Coolongolook River (the Wang Wauk and Wallingat Rivers flow into the Coolongolook River). The Wallamba River has the largest sub-catchment (approximately 437 km²) and makes up approximately one third of the entire Wallis Lake catchment (1440 km²) (Wallis Lake Estuary Management Committee 2005).

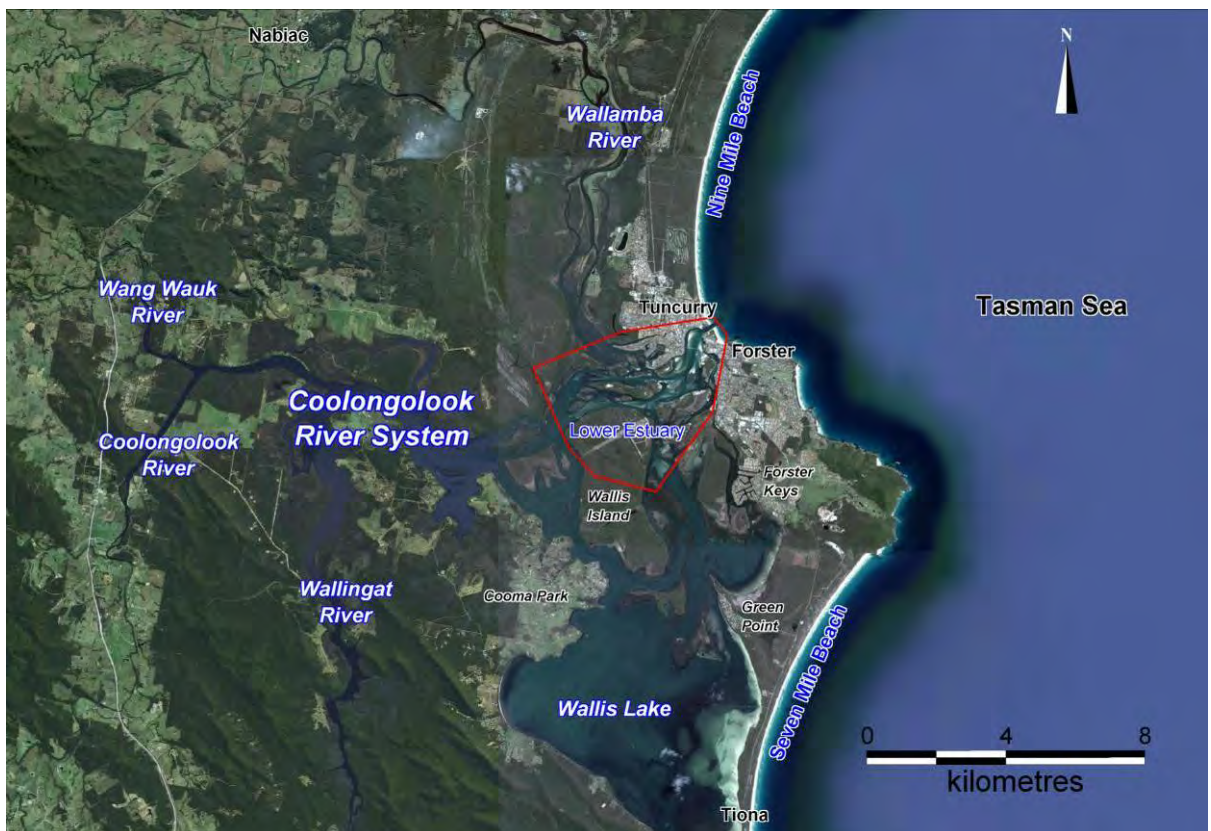


Figure 1.1 Study Area

1.3.1 Entrance, Islands, Oyster Lease Areas and Navigation Channels

The southern breakwater was constructed in 1898 and extended in 1966. The northern breakwater was completed in 1966, forming the Tuncurry Rockpool (Webb McKeown 1999). The rockpool was created as a 'wave trap' to dissipate wave energy entering Cape Hawke Harbour and quickly became a popular swimming spot. In the 1970s a net was installed to define the swimming zone and prevent bathers being swept out into the channel (www.greatlakes.nsw.gov.au – pools and beaches).



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Wallis Lake consists of many bays, islands, shoals and channels (see **Figures 1.1** and **1.2**). As noted in **Section 1.1** Wallis Island is the largest. To the north of this is Tuncurry and the Wallamba River entrance; to the east Forster and Forster Keys; to the south the main body of Wallis Lake; and to the west Coomba Park and the Coolongalook River entrance.

Between Wallis Island and the Wallamba River are Mosquito, Twin, Club, Cockatoo and Mather Islands (the islands closest to Wallis Island). North of Cockatoo Island are Corstorphine, Cut, Bells, Long and Oaky Islands. At the entrance to Ohmas Bay (near the confluence of the Wallamba River and Wallis Lake) is Native Dog Island. To the north of Ohmas Bay is Jonnell Cove.

Towards the Wallis Lake entrance and the Forster-Tuncurry Bridge are Tern Island and an unnamed shoal, Haydens Spit, Miles (or Sandy) Island and Leon Island. Within the entrance (Cape Hawke Harbour) and north of the bridge is Co-op Island (sand shoal). There is also a sand shoal under the bridge on the Forster side near Miles Island.

To the east of Wallis Island (from north to south) are Godwin Island; and Hadleys, Tonys and Big Islands (which are connected to the foreshore at south Forster).

Yahoo and Snake Islands lie to the south of Wallis Island; with Durands, Regatta and Bandicoot Islands to the west at the confluence of the Coolongalook River.

Unvegetated dredge spoil from previous dredging works is a feature of many islands in the lower estuary (see **Figure 1.2**).

The oyster lease area known as The Paddock is located between Haydens Spit and Miles, Leon and Godwin Islands, see **Photo 1.1**. The oyster lease area known as The Stockyard is located between Wallis Point (at Hadleys Island) and Tonys Point (Tonys Island) see **Photo 1.2**.



Photo 1.1 The Paddock



Photo 1.2 The Stockyard



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Figure 1.2 Lower Estuary Features



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Wang Wauk (Boomers) Channel runs along the northern side of Wallis Island to the western dropover, which is located south of Mosquito Island. The Wallamba Channel to the western side of Wallis Island is located to the north of Mather, Cockatoo and Corstorphine Islands. The Cut branches off this channel into the Wallamba River. There is also a channel around Tuncurry Point on the eastern side of the Wallamba River to the Jonnell Cove development and Muddy Creek. Tuncurry Channel is located between the entrance and Tern Island.

Foster Channel runs between the entrance and Breckenridge Channel. Breckenridge Channel is located between the Forster foreshore and Miles, Leon and Godwin Islands. The main channel to the southern side of Wallis Island is along the northern side of Godwin Island (the access from the entrance and the northern part of Breckenridge Channel), then through Hell's Gate (western side of Godwin Island) which joins Breckenridge Channel and leads over The Step (southern dropover) located west of Tonys Island, see **Photos 1.3** and **1.4**.



Photo 1.3 Hell's Gate



Photo 1.4 The Step

Pipers Creek/ Pipers Channel is located between Forster/ Forster Keys and Big Island. Forster Keys (a canal estate) was developed in the mid-1970s with works including the partial closing of the upper Pipers Creek Channel. See **Figure 1.1** for location.

1.3.2 Foreshore/ Foreshore Reserves

Much of the foreshore of the lower Wallis Lake estuary is public open space. A brief description of the Tuncurry foreshore from the entrance, upstream to the Wallamba River entrance follows. Refer to **Figure 1.2** for locations discussed below.

The easterly section of dune at the entrance see **Photo 1.5** was created by the build-up of sand following construction of the breakwater. Dune management works have been carried out by the Tuncurry Dunecare Group since 1991 to stabilise this area. It currently comprises a vegetated frontal dune backed by a wide swale, which is more sparsely vegetated. A 'botanic walk' has also been established by Dunecare. Adjacent to the northern breakwater/ training wall are the entrance leads, a cardinal mark and tide gauge. A concrete path runs adjacent to the training wall and along the top of the breakwater. Light poles, seating and shelters are located along the path, see **Photo 1.6**



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Photo 1.5 Tuncurry Beach



Photo 1.6 Looking towards the Rockpool

The reserve at the end of Rockpool Road contains a netted pool (between the inner and outer training walls), beach shower, pole with spotlights near the pool, kiosk and toilet block, carpark, picnic shelters, seats, playground to the north of the carpark and Dunecare shed at the north-western end of the open parkland.

There is one pedestrian beach accessway off the breakwater path and one from the carpark at the end of Rockpool Road. To the north there are several beach accessways from the caravan park. The 4WD access track and another pedestrian accessway to the beach lead from a carpark off Beach Street, north of the caravan park.

There is a footpath along Rockpool Road with a few Norfolk Island pines between the path and training wall. Within Oxley Park a path is located adjacent to the training wall (light poles are located along the path). It comprises concrete and asphalt sections and a pedestrian bridge over a small tidal pool. The park includes fishing fleet jetties and mooring piles (power box to each jetty), the Fishing Co-op building, public wharf (for loading and unloading only) and Fishing Co-op slipway/ boat ramp to the south of the Co-op building, see **Photos 1.7** and **1.8**.



Photo 1.7 Fishing Fleet Jetties/ Moorings



Photo 1.8 Co-op Slipway



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A sloped, rock training wall extends to the Fishing Co-op slipway. South of this point is a vertical rock/ concrete seawall. Rock riprap extends out to the first pylon at the Forster–Tuncurry bridge which extends upstream of the bridge and around to Boatland Marine, see **Photos 1.8** and **1.9**.

John Wright Park is located between the Co-op building and the bridge. It includes a concrete path near the seawall, fishing fleet jetties and mooring poles, and parking and picnic facilities (the park facilities were relatively recently upgraded by Council).



Photo 1.9 John Wright Park
(looking towards Fisheries' Boatshed)



Photo 1.10 Fisheries' boat ramp

Memorial Park, immediately south (upstream) of the bridge contains a disused boat ramp, Department of Primary Industries (DPI) Fisheries' boat ramp, jetty and shed, see **Photo 1.10**.

Boatland Marine and associated slipway and marina moorings are located along the Palm Street foreshore (refer to **Photos 1.11** and **1.12**). A public pontoon/ jetty, boat ramp and oyster farmers' moorings/ jetties are located along the Point Road foreshore, see **Photos 1.13** and **1.14**. A public reserve (Point Road Reserve) is located at the end of Point Road.



Photo 1.11 Foreshore near Boatland Marine
(looking downstream)



Photo 1.12 Boatland Marine



Photo 1.13 Public Jetty and Boat ramp



**Photo 1.14 Point Road Foreshore
(looking downstream)**

Opposite Tuncurry, the Forster/ Breckenridge Channel foreshore includes the coast guard building, Forster Marina, boat ramps, trailer and car parking, public wharves and commercial boatsheds and marinas (boat hire, tourist boats and Barclay's oyster shed and lease area).

1.4 Study Background

1.4.1 Wallis Lake Estuary Management Plan

The *Wallis Lake Estuary Management Plan* (Wallis Lake Estuary Management Committee 2005) identified the following areas for dredging, listed in order of priority:

1. Point Road boat ramp (eastern end of Tuncurry Channel)
2. northern point of Godwin Island (channel between Godwin and Leon Islands)
3. entrance to Pipers Creek (Pipers Channel)
4. bridge end of Breckenridge Channel
5. southern point of the entrance to Ohmas Bay
6. north-eastern point of Wallis Island (northern end of Hell's Gate / navigation channel to The Step)

Hell's Gate/ the navigation channel to The Step is the main access for recreational and commercial vessels (tourism and fishing/ oyster farming activities) from the Wallis Lake entrance and boat ramps around Forster/ Tuncurry travelling to and from Forster Keys, Green Point and the main body of Wallis Lake (see **Figure 1.1**).

In 2005, channel markers at The Step were removed by NSW Maritime, as safe navigation could not be guaranteed. In November 2010 one of two proposed starboard marks (nav aid number 119) was reinstated, with there being insufficient water depth to reinstate the second starboard mark.



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The *Wallis Lake Estuary Management Plan* also identified the need for a long-term solution to the sustainable management of sediment accretion in the entrance area and to protect *Posidonia* beds downstream of The Step.

Tern Island was previously identified as a disposal site for material dredged from the lower estuary but this did not proceed beyond the environmental impact assessment stage due, in part, to noise concerns (proximity to residential development) and that this disposal site would have a limited lifespan (estimated at 10 to 15 years).

To cater for disposal of dredged spoil beyond a 10 to 15 year timeframe, Great Lakes Council proposed pumping sand to a section of Tuncurry Beach adjacent to the breakwater. As dredging for maintenance of navigation channels and access/ maintenance of oyster leases is ongoing, a permanent pipeline was put forward by Council to transport dredged marine sands from the lower estuary to Tuncurry Beach.

The general maintenance dredging zone is indicated in **Figure 1.3**. Dredge volumes were estimated at up to 20,000 m³/year. It was assumed that only areas within the estuary comprising clean marine sands would be dredged for the purposes of disposal on Tuncurry Beach.

1.4.2 Forster-Tuncurry Crown Harbour Project

Concepts for development/ improvements to the Forster-Tuncurry foreshore (prepared by City Plan) were released by the Land and Property Management Authority (LPMA) for discussion. The masterplan report presents a 30 year vision for the ocean foreshore (from the sportsfields on the northern side of Tuncurry to the ocean pool at Forster) and the lower Wallis Lake estuary foreshore (from the entrance to the western end of Point Road, Tuncurry and on the Forster side to just south of Barclay's oysters). Accordingly the project has the potential to influence/ impact on the location of a permanent dredge pipeline to Tuncurry Beach.

The concept plans include:

- Relocating the Fishing Co-op to a new harbour/ marina at Tuncurry, to the east of Beach Street (on the site of the present caravan park) with tourist accommodation located around the new harbour.
- Upgrading Oxley Park (present location of Fishing Co-op) at Tuncurry. As noted in **Section 1.3.2** the adjacent John Wright Park (eastern side of the Forster-Tuncurry Bridge) has already been upgraded and Council has developed designs for upgrading Memorial Park on the western side of the bridge.
- Providing about 100 moorings for the commercial fishing fleet and recreational vessels between Point Road and Tern Island and associated dredging.
- Constructing a road bridge to Tern Island with the eastern end of the island used as a picnic area and the western end used as a sand disposal site for 15 years, after which it would be developed as a campground.
- Reconfiguring the existing Forster marina for possible alternative uses upon establishment of the Tuncurry Marina.



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- Dredging to create a new tidal pool adjacent to the training wall upstream of the Forster Marina.
- Pedestrian bridge (high enough to maintain navigation for vessels currently able to travel under the Forster–Tuncurry Bridge) over Breckenridge Channel to Miles Island.
- New jetty and boat ramp near Barclay's oyster depot.

1.5 Summary of Previous Studies on Dredging and Disposal Sites

1.5.1 Tuncurry Channel and Pipers Creek REFs 2010

The Review of Environmental Factors (REF's) for these projects were prepared by Great Lakes Council (GLC). The intention of the dredging was to remove the prograding front of the sand bank to restore the navigation channel to a design depth of -2.5 m below Australian Height Datum (AHD) in the vicinity of the Tuncurry boat ramp. The dredge footprint was 6,000 m², based on a channel 30 m wide and 200 m long (extending from the boat ramp to Boatland Marine). The quantity of clean marine sand to be removed was estimated at 9,000 m³ (approximately 17,000 m³ was later removed).

Two temporary stockpile sites were identified in the REF (see **Figure 1.1** for locations listed below) with material to be carted away by the purchaser:

- Fazio Park (capacity 9,000 m³)
- Point Road Reserve, used previously for dredge spoil deposition (capacity of existing bunded area being 4000 m³) (GLC 2010a)

Pipers Channel is located to the south of the Forster town centre and is the only navigation channel from Forster Keys to Wallis Lake. There are approximately 350 residences at Forster Keys with direct canal frontage, as well as a public boat ramp.

Pipers Channel was created by dredging an artificial channel to Pipers Creek in the late 1960s/ early 1970s. Since this time reports from NSW Maritime indicated a slow shallowing of the channel with craft (particularly larger vessels) running aground on low tides. Dredging was proposed from the shoaling sand bank located at the entrance to the channel, for a distance of approximately 180 m along the prograding sand bank. The design channel width was a minimum of 15 m, with a design depth of -1.7 m AHD. The dredge footprint covered an area of 2,700 m², with the estimated and actual volume of material removed being approximately 4,000 m³.

The dredged material was temporarily deposited on Forster Keys Foreshore Reserve (the area available for deposition and temporary storage was about 5,800 m²). From there it was transported and used for fill for the planned sportsfields at the nearby Lakes Estate (GLC 2010b).

1.5.2 Oyster Lease Dredging (mouth of Wallamba River) EA 2006

The Director-General's report (DoP 2009) noted that oyster lease (OL) 80/78 was established around 100 years ago and was last dredged in 1981, and that due to sedimentation no oysters had been farmed on the lease since the mid 1990s (although some oyster spat was grown from time to time).



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This proposal related to:

- Dredging (200 mm cutter suction dredge) an area of 8 ha within OL 80/78 at the mouth of the Wallamba River (adjacent to Oaky Island) to a depth of up to 2 m below mean low water mark or around -2 m AHD (approximate volume of 149,000 m³).
- Pumping the dredged material about 4 km up the Wallamba River to a processing and stockpile site off Grey Gum Road (approximately 2.57 km of pipeline submerged on the river bed and approximately 1.63 km of pipeline traversing private land to the processing/ stockpile site).
- The use of three booster pumps, two on barges in the Wallamba River, one on land.
- Construction of two settling ponds, 17,500 m² and 7,800 m² in area with capacities of 45 ML and 18.4 ML respectively.
- Pumping 5,500 m³ of sand and 11,000 m³ of water over a 5.5 day week.
- Sale of the sand (most likely for land fill) over a period of approximately 15 years.

This proposal did not proceed.

1.5.3 Renewable Sand Depot Tern Island EIS 2005

As noted in this EIS, prepared by Web McKeown, sand from past dredging of oyster leases was deposited on islands in the lower estuary. This practice substantially changed island landforms, degraded natural vegetation, facilitated weed growth and altered habitat and visual and recreational amenity. In addition, the long term storage capacity of many of the islands was exceeded, resulting in the stockpiled sand being eroded by wind and wave action and returned to the estuary.

Webb McKeown investigated alternative dredging and disposal options, including disposal sites close to the majority of previously dredged areas. The sites reviewed were Forster Breakwall, Fishing Co-op Island, Point Road Reserve and Tern Island. Tern Island, with a low level bridge connection to Point Road, was identified as the most suitable site for a renewable sand depot. Over 100,000 m³ of marine sand up to a height of 9 m covers approximately half the island. Deposition of dredged sand commenced prior to 1930 and continued up until 1990, and more recently in 2012.

The initial stage of the project was to remove up to 80,000 m³ of sand already deposited on Tern Island. The estimated volume of sand to be dredged from navigation channels, oyster leases and transported from other islands (previous fill disposal areas) was estimated at an average of 20,000 to 30,000 m³ of material per year. Miles, Godwin and Mathers Islands were identified as potentially being suitable for rehabilitation upon removal of dredge spoil. It was noted that the Miles Island deposit exceeded 100,000 m³ and consisted of largely unvegetated, clean marine sands.

The capacity of the proposed 3 ha bunded depot area on Tern Island was 60,000 m³ (height approximately 5 m AHD). It was proposed to use Tern Island over a period of 10 to 15 years, after which the island would be rehabilitated with a final fill level of around 2 m AHD, or just below the 100 average recurrence interval (ARI) flood event.



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Issues associated with the use of Tern Island as a sand depot were identified as:

- changes to Tern Island's visual features as seen from adjoining areas, including the Point Road foreshore
- traffic impacts on residential areas adjoining Point Road
- noise impacts on residential areas adjoining Point Road
- maintenance of water quality in Wallis Lake
- impacts on estuarine fauna using Tern Island
- rehabilitation of Tern Island vegetation
- enhancement of Tern Island's recreation values.

This proposal did not proceed.

1.5.4 Oyster Farm and Navigation Channel Dredging – Disposal Strategy 1988

This report was prepared by the Public Works Department (PWD) to assist Council in developing a five year dredging disposal strategy. It was noted that over previous years there had been a continuing need to dredge the entrance channels of Wallis Lake to maintain adequate water depths in navigation channels and oyster leases. As previously mentioned, dredge spoil had historically been disposed of onto a number of islands or was used to reclaim waterway areas to create islands, such as Miles Island. It was recognised that the capacity of these sites was limited,

The residual capacity of former disposal sites was estimated at 230,000 m³ (two former sites on Cockatoo Island were excluded because they were within littoral rainforest, along with Wallis Island where the then Department of Lands was developing a recreational facilities plan).

PWD examined past dredging activities to identify historical trends. Navigation channel dredging between 1971 and 1988 removed 174,000 m³ of material (an average of 10,000 m³ per annum). The determination of oyster lease dredging applications (by the then Crown Lands Office) between 1976 and 1988 resulted in:

- 157,000 m³ of material being removed
- 97,500 m³ of dredging being refused (based on concerns relating to the destruction of seagrass beds, creation of additional flow channels, redirection of flows onto adjacent leases and foreshore erosion)
- 88,820 m³ of dredging being approved pending the results of the PWD study.

PWD estimated the likely future dredging requirements from 1988 to 1993 as:

- 65,000 m³ for navigation channels
- 180,000 m³ for oyster leases (including the 88,820 m³ listed above as pending approval).



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As the future dredging disposal requirements (245,000 m³) exceeded the capacity of existing sites (230,000 m³) PWD investigated a number of alternative disposal sites. Of the 18 potential sites, 10 were identified as feasible based on a preliminary assessment that potential ecological impacts would not be significant (total capacity of 406,000 m³).

At the time of the study both BMG and Readymix were contacted but considered use of the dredged spoil for commercial purposes to be financially unviable, even if royalties were waived.

PWD developed a disposal strategy, based on a dredge pumping distance of 1 km which would enable disposal of approximately 70% of the predicted dredge volume at identified lower estuary sites. The remaining dredged material would need to be disposed of at more remote sites, using booster pumps or a barge operation. All disposal site works were to include:

- use of bund walls
- use of numerous compartments (if possible) to permit progressive revegetation of the site
- stabilisation, revegetation and removal of rubbish from the site.

1.5.5 Forster Keys Canal Estate Hydraulics and Ecology – An Overview 1990

Australian Water and Coastal Studies (AWACS) in conjunction with JH and ES Laxton completed an options report for a navigation channel from Pipers Creek to Breckenridge Channel. Option 1 involved dredging a channel from a point north of Wyuna Place within Forster Keys, adjacent to the eastern side of Pipers Creek, connecting to Breckenridge Channel adjacent to Barclays oyster depot. Option 2 included dredging an existing channel adjacent to Lani's Holiday Park with a connection to Breckenridge Channel further to the west.

1.6 Consultation

Letters outlining the Study were sent to 74 stakeholders with an invitation to meet and discuss the project in more detail. Stakeholders comprised government agencies which were likely to have an approvals role for dredging/ deposition of sand and other stakeholders who may potentially be impacted by dredging, the pipeline route and beach nourishment. Organisations contacted included:

- Department of Primary Industries (DPI) Fisheries
- NSW Maritime
- Land and Property Management Authority (LPMA)
- Regional Development Australia (RDA)
- Department of the Environment, Climate Change and Water (DECCW)
- NSW Marine Parks Authority
- NSW National Parks and Wildlife Service - Booti Booti National Park
- Wallis Lakes Shellfish Program



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- Wallis Lake Fishermen's Co-operative
- Oyster Farmers Association
- Forster Tuncurry Memorial Services Fishing Club
- Foster Keys Progress and Ratepayers Association
- Great Lakes Environment Association
- Wallis and Smiths Lake Estuary and Coastal Committee community members
- Dunecare
- Forster Local Aboriginal Land Council
- Numerous private oyster farmers with leaseholds in Wallis Lake
- Local charter operators (including dive, dolphin watching, fishing and recreational boat hire)
- Great Lakes Surf School
- Forster Tuncurry Surf School.

Written submissions were received from:

- DECCW
- Forster Keys Progress and Ratepayers Association
- Tuncurry Dunecare Group.

In addition signs were erected at Tuncurry Beach in mid August 2010 to advise local beach goers/ surfers/ anglers of the proposed pipeline and beach nourishment works, with an invitation to contact WorleyParsons for further information or to provide comment.

The following organisations/ individuals arranged to meet with representatives of WorleyParsons on Wednesday 18th, Thursday 19th August or Wednesday 2nd September 2010.

- Wallis Lake Fishermen's Co-operative
- NSW Maritime
- NSW Fisheries
- NSW Oyster Farmers Association
- LPMA (Land Management, Commercial and Minor Ports representatives)
- Free Spirit Cruises
- Boatshed No. 1
- Boatland Marine
- Tuncurry Dunecare Group.



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Phone calls were received from the following stakeholders:

- a local resident and Tuncurry Beach surfer
- Blue Peter Boatshed.

A summary of written submissions, meeting and telephone discussions are provided in **Table 1.1**. The mailing list and correspondence sent to stakeholders is included in **Appendix A**, together with pipeline and channel options used for discussion purposes with representatives from agencies, organisations and businesses.

Table 1.1 Summary of Stakeholder Consultation

Stakeholder	Study Aspect	Issue/ Comment
NSW Maritime	Pipeline	<ul style="list-style-type: none"> - the tip of Tern Island is suggested as the pipeline intake location - in terms of navigation, a pipeline on the bed of the estuary would be preferable possibly running down the centre of the channel adjacent to Point Road before joining the foreshore - submerged pipelines need to be at an adequate depth so they do not pose a navigation hazard and no anchoring signs would need to be installed - if the pipeline was run along the seawall/ training wall above high tide from near Boatland Marine this would reduce the possibility of recreational anglers fouling lines on the pipeline or the pipeline being damaged/ ripped up by anchoring boats - near Tuncurry Beach, the pipeline road crossing could possibly be via the stormwater pipe system - potential for sand pumped into the water on the northern side of the breakwater to enter the entrance channel under local currents - if a pipeline was used to transport material dredged from The Step it should be located on Wallis Island or completely sunk on the bed, however the location of prawn pegs and oyster leases may make laying the pipeline difficult – laying the pipeline on the eastern side of the prawn pegs or within the boundary of the oyster leases may reduce impacts on navigation
	The Step dredging	<ul style="list-style-type: none"> - dredging The Step is likely to enhance recreational use of Wallis Lake and allow larger boats from Forster Keys and Pipers Creek to access the lower estuary - there are two markers at The Step but there is no record of the exact location of the old channel markers that were removed around 2002 (two starboard navigation channels were to be installed in 2010 but only one was installed due to insufficient navigation depths) - the dredged channel should be at least 2 m deep and 30 m wide consistent with recent navigation dredging works in Wallis Lake - the preferred option is the more natural western channel, however, the eastern channel option may be feasible if the channel was cut through south of the last oyster lease rather than continuing downstream between the leases – this option would require removal of less material and provide access to water depths of 2 to 3 m



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Stakeholder	Study Aspect	Issue/ Comment
		<ul style="list-style-type: none"> - it was suggested that the oyster leases at Hell's Gate be removed instead of dredging this area – the leases currently lie over the deepest section of this channel and are little used and not particularly productive due to the strong currents in this area
Forster Keys Progress and Ratepayers Association	The Step dredging	<ul style="list-style-type: none"> - supports proposal to dredge a channel at The Step - the shoal at The Step is encroaching on seagrass beds and it is thought likely that it is impeding tidal flows - suggested other locations for dredging: <ul style="list-style-type: none"> northern end of the channel between Godwin and Wallis Islands which leads to The Step Breckenridge Channel on the southern side of Godwin Island and a smaller section from the bridge to the boatsheds opposite the end of Helen Street so that boats can travel further away from Miles Island which is used as a base for swimming during summer Pipers Creek at the end of the northern most canal in Forster Keys and a channel to connect Pipers Creek to Golden's Bay on the western side of Big Island (the later proposed to improve tidal flushing of Pipers Creek and Forster Keys)
	Pipeline	<ul style="list-style-type: none"> - pipeline route should take into account the location of other areas that require dredging
	Tuncurry Beach nourishment/ alternatives	<ul style="list-style-type: none"> - dredged sand has economic value as fill is required for local development to meet design flood levels
Boatshed No. 1 – Houseboat Charter Operation	Pipeline	<ul style="list-style-type: none"> - access to the lake during dredging operations particularly if floating pipelines are used
	The Step dredging	<ul style="list-style-type: none"> - prior to 1961 a dredge cleared the navigation channel near the Forster–Tuncurry Bridge with spoil deposited on the island opposite Forster [Miles Island] - houseboats only need ~ 2 ft of water depth - the Western Step is a much higher priority for dredging for this business
	Tuncurry Beach nourishment/ alternatives	<ul style="list-style-type: none"> - dredge spoil should be used to fill Lani's land
Free Spirit Cruises	General/ The Step dredging	<ul style="list-style-type: none"> - operates largest commercial vessel (<i>Spirit</i> has an 8 ft draft) on Wallis Lake and goes out five to six nights a week in the 6 weeks prior to Christmas – the largest tourist vessel the <i>Amaroo</i> only goes around the entrance area and out to sea - generally there is little boating on Wallis Lake - typically sees two or three boats fishing on The Step during busier periods (weekends, holidays) – from September onwards there are more boats using the



Wallis Lake Dredging and Disposal Options Assessment

Stakeholder	Study Aspect	Issue/ Comment
		<p>lake including cruisers - kayaking and canoeing has become popular in the last couple of years</p> <ul style="list-style-type: none"> - The Step channel has been deepening over the last couple of years, the western channel is used to cross The Step - in the last 12 months sand has built up on shoals between The Paddock and Mather Island - if the channel to The Step was a little deeper it would eliminate the element of risk as on low tide when the <i>Spirit</i> is fully laden Hell's Gate is a bit tricky to navigate
Blue Peter Boatshed	General/ dredging	<ul style="list-style-type: none"> - have seven hire boats, 4.3m long with 6 horse power outboard motors which can do 10 knots (mainly hired for recreational fishing) and boats use their mooring during holiday times (trailerable boats) – also hire out kayaks - entrance to the channel access to the boatshed is silting up – they have put in two white buoys to guide hire boats – sometimes have to lift motors out of the water for access - sand bars are silting up around Leon and Godwin Islands - Breckenridge Channel is shallow on low tides - also shallow further out towards oyster leases (The Paddock) and the bridge - large boats can't get out the end of Breckenridge Channel near Barclay's oyster shed
Boatland Marine	Tuncurry Beach	<ul style="list-style-type: none"> - there was a 'mini bar' at Tuncurry Beach four to five years ago which provided good surfing off the breakwater - a SE storm in March or July four or five years ago moved sand and increased depths over the mini bar
	General/ dredging	<ul style="list-style-type: none"> - in 1927 there was major flooding of Wallis Lake - there was continual dredging when the vehicle ferry was in operation - sand pumped from the old vehicle ferry area and The Paddock was deposited on Tern Island - dredged sand was used to increase the height of Co-op Island - channel used to be 10 to 20 ft deep along Point Road - around 1985 the breakwater was extended - the current depth of channels limits boating on Wallis Lake – during summer and Easter the Boatland Marine workshop is busy fixing bent propellers and gearboxes from visitors who strike sandbars - during floods sand from the Western Step is pushed around to The Step - areas that have silted up are the Western Step, Hell's Gate, The Step and the sandspit just west of the bridge - Mather Island is close to breaking through
	The Step dredging	<ul style="list-style-type: none"> - it used to be deeper (8 ft) though the middle of The Step about 10 years ago



Wallis Lake Dredging and Disposal Options Assessment

Stakeholder	Study Aspect	Issue/ Comment
	Tuncurry Beach Nourishment/ alternatives	<ul style="list-style-type: none"> - could use bottom dumping barge for The Step – barge sand from The Step or could have a pipeline from The Step to Cockatoo Island - dredging an eastern channel is out - dredged sand should be used or sold for fill, e.g. for Fazio Park, Pipers Creek behind school playing fields, southern parkway, private land for development on Tea Tree Road on the southern side of Folly Foot Farm - 1.5M m³ of sand could be available from oyster leases, navigation channels, restorations (dredged material previously dumped on islands from oyster farm dredging) - the western end of Tern Island could take 150,000m³ of sand – sand could be trucked away - 200,000m³ to 300,000m³ of dredge spoil from Godwin plus Cockatoo Islands (dredged sand dumped on NPWS land) could be pumped to Tern Island - estimated the sale price of delivered clean sand would be \$42/ m³ and it would cost \$15/ m³ for dredging
Department of Primary Industries NSW (Fisheries)	Pipeline	<ul style="list-style-type: none"> - seagrasses occur in the vicinity of Tern Island and the protected Estuary Cod occurs in the vicinity of the Forster–Tuncurry Bridge - suggest pipeline with inlet off eastern end of Tern Island and running down centre of channel to bridge where it could then run along the training wall - a submerged pipeline adjacent to Point Road would encroach on areas of seagrass and may have an impact on oyster farmers who launch vessels from the foreshore - the pipeline would need to run either underneath the Fisheries' boatshed ramp against the seawall or out deeper on the bed of the lake
	Dredging of The Step	<ul style="list-style-type: none"> - Estuary Cod, seahorses and pipefish occur around the coffee rock which occurs through the channel to The Step - recreational prawning, crab trapping and angling occur in the channel and over The Step - commercial prawn fishing (set pocket technique) occurs in the channel upstream of The Step - commercial crab trapping occurs in the channel - commercial fish netting occurs in the channel and around The Step (gill netting) - a commercial fish hauling shot is located near the eastern end of Dago Island and runs over The Step - removal of the sand plug at Hell's Gate could be an issue as this could increase current velocities, potentially affecting the prawn fishery in the channel - purchase and removal of the oyster leases (or modification of lease boundaries) on this corner is considered preferable for navigation purposes – although the leases are currently included within the Wallis Lake 'priority aquaculture area' they are not used to full potential, partly due to strong currents



Wallis Lake Dredging and Disposal Options Assessment

Stakeholder	Study Aspect	Issue/ Comment
		<ul style="list-style-type: none"> - dredging The Step could cause increased flow rates on the run in and run out tides with potential implications for erosion and the surrounding oyster leases – increased tidal flows may also impact on the prawn pegs which are located in the channel and the way in which the prawn fishermen undertake their work - potential scouring of <i>Posidonia</i> beds adjacent to The Step due to increased flow rates following dredging
	Tuncurry Beach nourishment	<ul style="list-style-type: none"> - impact on habitat if sand was placed on the dune - sand should not be placed on the beach during the Mullet run (April to June) - changes to the seafloor topography could impact on the Mullet run (if sand was deposited below low water mark)
Wallis Lake Fishermen's Co-operative	Pipeline	<ul style="list-style-type: none"> - pipeline would need to be buried along the foreshore to maintain access to boat ramps, jetties and carparking - pipeline would need to be trenched under boat ramps or go out and around ramps at sufficient depth to avoid boats or trailers being caught - the Co-op slipway tracks extend approximately 30 m out from the shoreline and the pipeline would need to run out and around this - if submerged the pipeline should be laid out from the Co-op foreshore to avoid boat collisions and weighted appropriately, given the strong currents in this area - the Co-op has 20 year leases over the jetties along Point Road and around the Co-op building as well as the Co-op land, carparking and slipway
	Tuncurry Beach nourishment/ alternatives	<ul style="list-style-type: none"> - beach hauling occurs along Tuncurry Beach for mullet from April to June – plant and machinery noise/ pumping sand onto the beach/ nearshore area should be avoided during this time - suggest sand is sold for fill as an alternative to beach disposal
	The Step dredging	<ul style="list-style-type: none"> - commercial prawning occurs through the main channel (Stockyards) running to The Step from August to April accordingly the best time for dredging would be in winter (May to July) - nine permanent prawn pegs are in place on the eastern side of the channel from which ropes and nets are set out to the western side of the channel to trees/ poles – if a pipeline was used to transport dredged sediment it is suggested it be located at least 10 m behind the tree line on Wallis Island (rather than being submerged) so it does not interfere with the setting of nets or the prawn pegs - current channel depths are sufficient for commercial fishing activities - the gutter at Hell's Gate has not changed in 30 years but the sand bank on the north-eastern side of Wallis Island has grown. - Hell's Gate should not be dredged as it is believed it buffers tidal currents (which are up to 3 knots) and if removed tidal currents would increase, potentially damaging upstream and down oyster leases and causing further erosion



Wallis Lake Dredging and Disposal Options Assessment

Stakeholder	Study Aspect	Issue/ Comment
		<ul style="list-style-type: none"> - The Step dropover has prograded into Wallis Lake by about 200 m in recent years - if any dredging occurs it should be of the naturally formed western channel which is currently used by vessels – the natural shoals being colonised by seagrasses should be retained - the end of The Step (dropover) should also be dredged so that sand from this area does not infill the newly dredged channel
Oyster Farmers NSW	Pipeline	<ul style="list-style-type: none"> - will the pipeline be available for dredging of oyster leases and what would be the cost to oyster farmers? - a proposal for a pipeline running from The Step directly east to behind the Tavern has previously been mentioned
	Tuncurry Beach nourishment/ alternatives	<ul style="list-style-type: none"> - sand should be seen as a commercial asset and sold for other uses (e.g. landfill) – five years ago the price offered for dredged sand was \$30 to \$35 m³. - a number of alternative deposition sites are possible (see maps in Appendix A which show deposition sites that have been used in the past) e.g. Tern island (much of the material deposited on the southern side has washed away), Mather Island, developments such as Lani's Caravan Park, land fill for lower lying areas in Tuncurry and Forster. - the eastern end of Mather Island (previously formed by dredged spoil) should be used as a deposition site to maintain the barrier which currently separates the three main oyster harvest areas which are affected by different inputs (i.e. ocean, Wallamba River and Wallis Lake) - the end of Mather Island especially protects the central oyster growing area (The Paddock) where oysters are grown to size as the Wallamba River water which flows along the northern side of Mather Island is more polluted than water flowing on the southern side.
	The Step dredging	<ul style="list-style-type: none"> - sand deposition used to occur at the Paddock and the point (Cable Point) used to be approximately 200 m longer and 6 ft higher. - consider that there are much more important areas to dredge in Wallis lake (e.g. around the oyster leases) as listed at the end of this table (see maps in Appendix A). - the oyster leases on Hell's Gate corner are deepening and are almost unusable due to strong currents - there is potential to remove these leases to improve navigation (note that some oyster racks have been removed) - if dredging occurs it should be undertaken between April and September (outside the oyster harvest period, October to March).
Land and Property Management Authority (LPMA)	Pipeline	<ul style="list-style-type: none"> - Fazio Park is Crown land vested in Council, land east of bridge is Council freehold and there is a 100 ft foreshore reserve around most private land surrounding Wallis Lake - LPMA administers leases for the Co-op jetties, five on the eastern side of the Co-op are leased directly to fishermen with the rest leased to the Co-op - the Forster–Tuncurry Crown Harbour Project has implications for the pipeline as follows: <ul style="list-style-type: none"> - a new harbour (30 year project) is proposed to be excavated at



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Stakeholder	Study Aspect	Issue/ Comment
		<ul style="list-style-type: none"> the current caravan park site (with vehicular and pedestrian bridges) with the Fishing Co-op relocated to western side of the new harbour - pipeline could be installed on vehicular bridge across proposed harbour
	Tuncurry Beach nourishment	<ul style="list-style-type: none"> - Tuncurry Beach dune is OK apart from a low spot – dredged material could be used there or considered for higher use e.g. land fill or for making concrete
	General/ Dredging and stockpiling	<ul style="list-style-type: none"> - May 2009 storm – water overtopped the sand bar (Co-op Island) adjacent to the entrance channel and moved sand around to Point Road bar on the southern side of bridge - As part of the Crown Harbour Project it is proposed: <ul style="list-style-type: none"> - to remove fore and aft moorings at Forster and replace these with new moorings located near Tern Island (this would require dredging) - that Tern Island be used as a dredged sediment stockpile site for the next 15 years (proposed bridge link from island to Point Road) after which it would developed as a campground – bridge should address neighbourhood noise concerns as material could be trucked north-east along Point Rd affecting fewer properties – original EIS involved trucking to the reserve at western end of Point Road
Local Resident / Surfer	Tuncurry Beach nourishment/ alternatives	<ul style="list-style-type: none"> - people do not surf Tuncurry Beach in winter as it becomes deep and dangerous - believes sand transported onto the beach during summer has been trapped in dunes (as a result of revegetation works by Dunecare) and therefore has not been transported back offshore in winter - sand is transported from the southern end of Tuncurry Beach around the breakwater and into the rockpool (Council removes at least 100, 10 tonne truck loads of sand each summer but this is not placed back on the beach) - accordingly believes pumping sand onto the beach will be a waste of money as it will then need to be removed from the rockpool and trucked away - Bennett's Head at Forster is a site more in need of beach nourishment
Tuncurry Dunecare Group	General	<ul style="list-style-type: none"> - dunes have moved further seaward, shoreline used to be located at approximately the eastern side of the carpark at the rockpool - originally the breakwater was only constructed to the corner of the pool - in the late 1950s/ early 60s the breakwater was extended to assist the commercial fishing fleet - 20 years ago the navigation channel was 100 m off Tuncurry channel and has been dredged once since - ebb tide runs at 7 to 8 knots and sucks out sand to the bridge area and then drops it on the entrance bar and the same sand comes back into the beach at the rockpool – the training wall on the southern side of the pool was built to create a sand trap



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Stakeholder	Study Aspect	Issue/ Comment
		<ul style="list-style-type: none"> - Council removes sand from the rockpool - since the 1960s sand from the bar has also moved to the northern side of the breakwater and this area has gradually built-up - since the 1970s the dune are has grown and moved forward - the foredune, swale, and secondary dune were constructed by Council - prior to dune stabilisation, sand blew into and covered the carpark - in 1991 marrum grass (as recommended by PWD at the time) was planted to stop sand drift on the dunes, French millet was planted in the picnic areas - swale area is too wide, and bakes as the nor'easter goes over the top of the foredune and the swale area doesn't receive any breeze – consequently it has taken a while to get plants to grow in the swale - since the 1990s there hasn't been much change in the dune - primary dune is very narrow just north of the access way from the carpark, a fence has been installed to try to collect sand – a big sea could break through in this location and flood the swale
	Tuncurry Beach nourishment/ alternatives	<ul style="list-style-type: none"> - Dunecare have installed a watering system (plastic hose) – could be moved if required for pipeline route - sand could be placed behind foredune to reduce the swale width and then the area could be replanted <p>Use of Tern Island as deposition site (personal response as local resident):</p> <ul style="list-style-type: none"> - opposed as this would lead to industrialisation of the area - proposed bridge would block channel - this would involve heavy machinery, sheds etc - would create traffic problems - need to look at ongoing disposal site for sand dredged from oyster leases

Dredging and Disposal Sites put forward by the Oyster Farmer representatives are shown in **Appendix A**. This relates to dredging:

- within The Paddock and the navigation channel between The Paddock and Godwin Island (access from Breckenridge Channel).
- top of navigation channel which leads to The Step (near north-western corner of Godwin Island).

Suggested disposal sites were as follows:

- Fazio Park and Point Road Reserve
- eastern end and southern side of Tern Island
- part of Long Island
- narrow spit of Mather Island and point (eastern end)



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- south-eastern end of Cockatoo Island
- north-western corner of the eastern part of Godwin Island
- western end of Hadleys Island.



2 STUDY AREA

2.1 Bathymetry

The most recent hydrographic survey was undertaken in 2010 (see **Figure 2.1** which indicates shallower areas in red/ orange and deeper areas in blue). This shows navigation channel depths west of the bridge generally around 3 to 4 m below AHD. The lower section of Breckenridge Channel beside Godwin Island is shallower, around -2 to -3 m AHD. Tuncurry Channel near the Tuncurry boat ramp was not included in this survey but the design depth for recent dredging was - 2 m AHD.

Navigation depths between The Paddock and Godwin Island; between Godwin Island and the eastern end of Wang Wauk (Boomers) Channel; and the deepest parts of the western and southern (The Step) dropovers are a maximum of about -2 m AHD.

Comparison of the 2010 hydrographic survey with the 1998 survey (see **Figure 2.2** which shows areas of deposition in green and areas of scour in blue) shows:

- deposition of sediment (shallowing) on the southern side of the bridge towards Tuncurry, with channel scouring to the east of this
- areas of deposition and scouring between Mather and Godwin Islands
- deposition at the northern approach to/ northern end of the navigation channel to The Step
- significant progradation of The Step dropover into Wallis Lake
- minor progradation of the western dropover (Western Step)
- shallowing of a previously deeper section of the Wallamba Channel, near Twin Islands
- scouring and deepening between the breakwaters
- deposition on the ocean side of the entrance bar (refer to **Appendix C** for more information).

2.2 Topography

The dunes at Tuncurry Beach reach a height of approximately 2.8 m AHD. As shown in **Photo 2.1** the dunes are backed by a wide swale. The dune is very narrow in a section between the beach access way from the rockpool carpark north to the beach access way from the caravan park, see **Photo 2.2**.

The foreshore elevation between the entrance and the downstream side of the bridge is around 1.6 m AHD. In the vicinity of the bridge the foreshore is about 1.3 m AHD with the foreshore along Point Road lower, around 1 m AHD.



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Photo 2.1 Tuncurry Dune and Swale



Photo 2.2 Tuncurry Dune

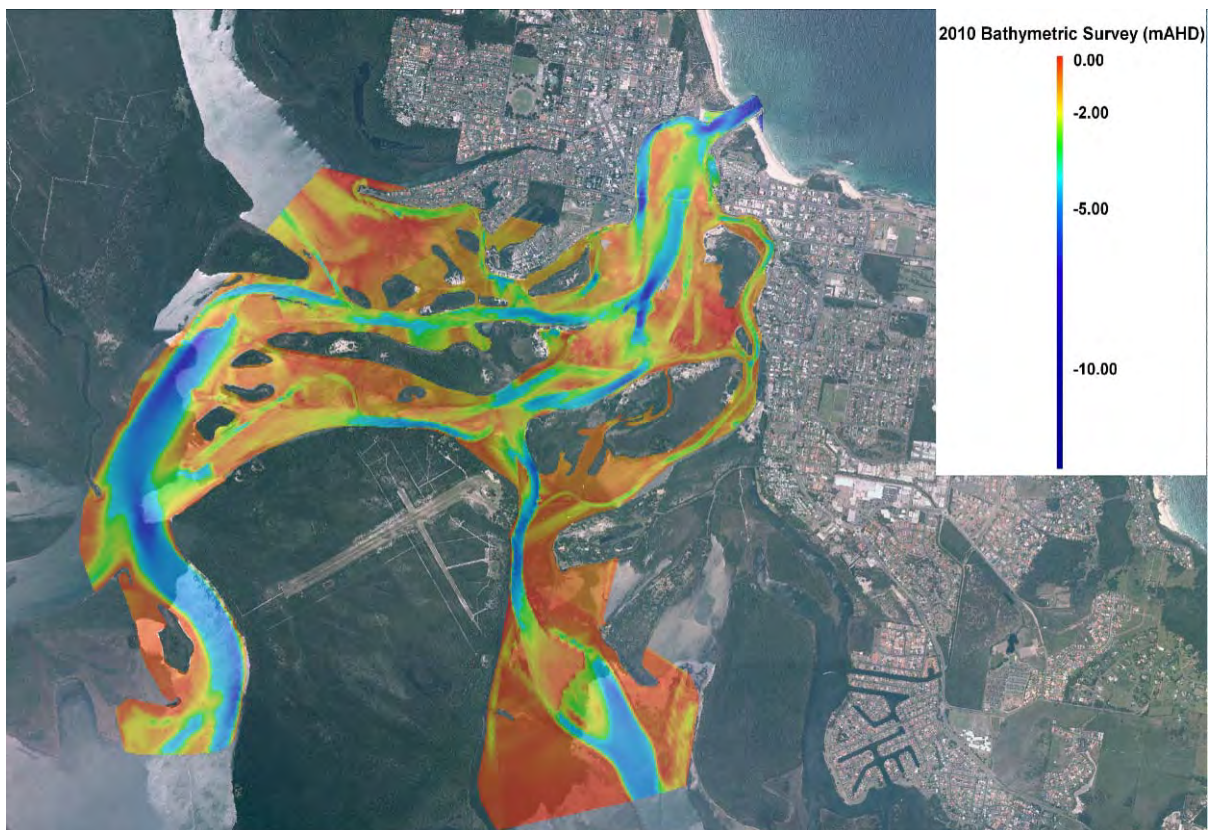


Figure 2.1 Bathymetric Survey 2010



Figure 2.2 Comparison of 1998 and 2010 Surveys

2.2.1 Services

Electricity, water, sewerage and telephone mains are shown in **Appendix B**. These figures indicate the presence of:

- all service mains generally located on the northern side of Point Road
- water and sewer mains along the northern side of the section of Palm Road fronting the foreshore
- all service mains along Manning Street/ Head Street and crossing the Forster–Tuncurry Bridge
- sewer main along Leomato Close in the vicinity of the Fishermen’s Co-op and, to the east, sewer, electricity and phone mains generally within the Leomato Close road reserve
- electricity and phone mains on Rockpool Road near Beach Street which extend to the foreshore in the vicinity of the fishing fleet jetties/ moorings
- electricity and phone mains generally along the northern side of Rockpool Road and crossing Rockpool Road to the foreshore at the western end of the western carpark within the rockpool reserve, as well as sewer, other electricity mains and water mains crisscrossing the carpark, eastern end of Rockpool Road and the triangular, grassed, foreshore area of the reserve (servicing the kiosk/ amenities block).



As noted in **Section 1.5.2** there is underground power to light poles along the northern breakwater and power to light poles and power boxes to the fishing fleet jetties/ moorings. In addition, a surface irrigation system has been installed by Dunecare, as noted in **Section 1.6**.

2.3 Zoning and Tenure

2.3.1 Land Use Zoning

The majority of land along the Tuncurry foreshore is zoned 6(a) (Open Space and Recreation) under the *Great Lakes Local Environmental Plan (LEP) 1996*, as are the beach reserves on the northern and southern sides of the entrance. The Fishing Co-op, Boatland Marine and the oyster farm buildings at the end of Point Road are zoned 3(d) (Special Business Waterfront), Barclay's oyster farm depot on Breckenridge Channel, on the Forster side of Wallis Lake, is also zoned 3(d).

The islands are generally zoned 7(a) Wetlands and Littoral Rainforest or 7(b) Conservation or a combination of these zones. The northern end of Wallis Island is zoned 7(b) with areas of 7(a) and 8(a) (National Parks and State Recreation) south of The Step. Refer to **Figure 2.3** for land use zones.

Residential zones 2(a) (Low Density Residential) and 2 (c) (High Density Residential) are located along Point Road. Part of the area along Rockpool Road is also zoned 2(a).

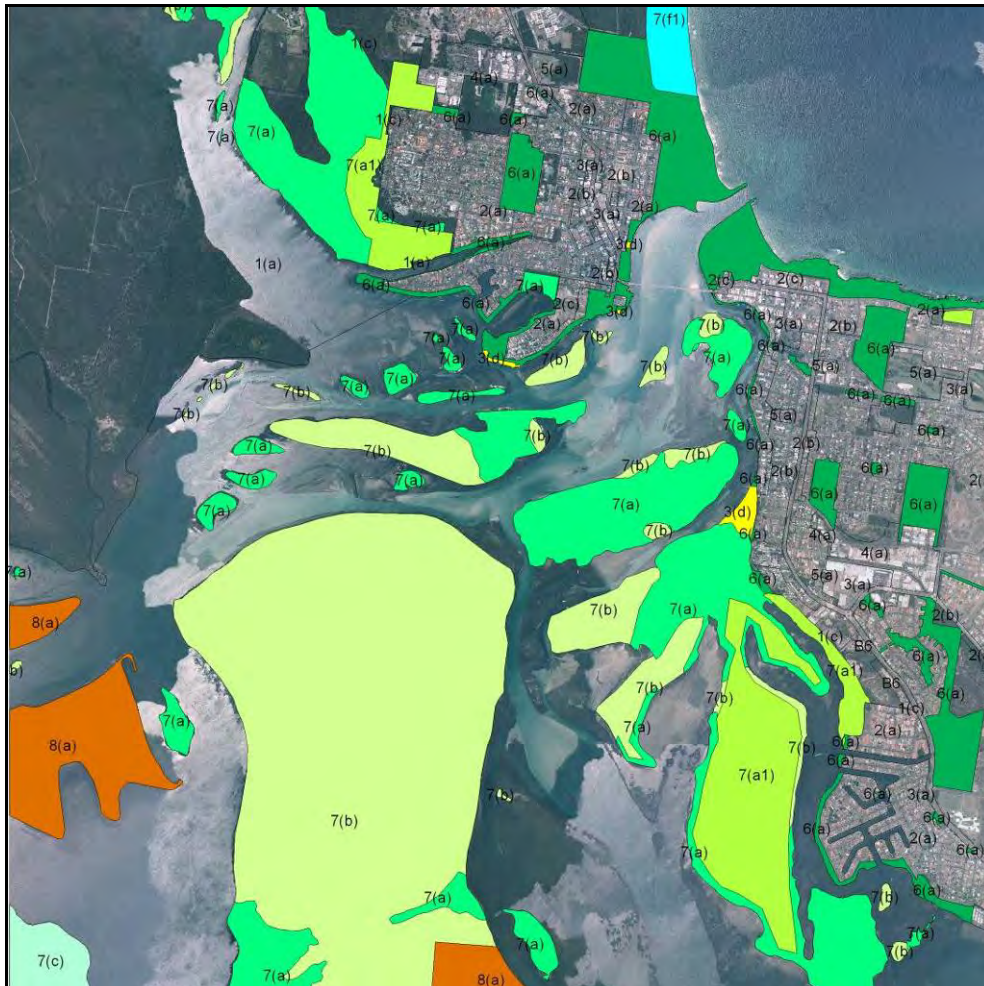


Figure 2.3 Land Use Zoning

2.3.2 Crown and Community Land

The majority of foreshore land around Wallis Lake is Crown Land. As noted in **Section 1.6** Fazio Park is Crown land vested in Council and land east of bridge is Council freehold ('Community Land' under the *Local Government Act 1993*). Around most private land at Wallis Lake is a 100 ft (30.5 m) Crown foreshore reserve. The majority of islands in the lower estuary are Crown land. The airfield area and south-western section of Wallis Island are freehold land.

2.3.3 Foreshore and Waterway Leases

Oyster leases closest to the Forster–Tuncurry Bridge are shown in **Figure 2.4**. Leases in the vicinity of The Step and in lower Breckenridge Channel area shown in **Figure 2.5**. As noted in **Section 1.6** the fishing fleet jetties/ moorings are leased by LPMA to the Co-op or directly to individual commercial fishermen. Boatland Marine also occupies a lease area.



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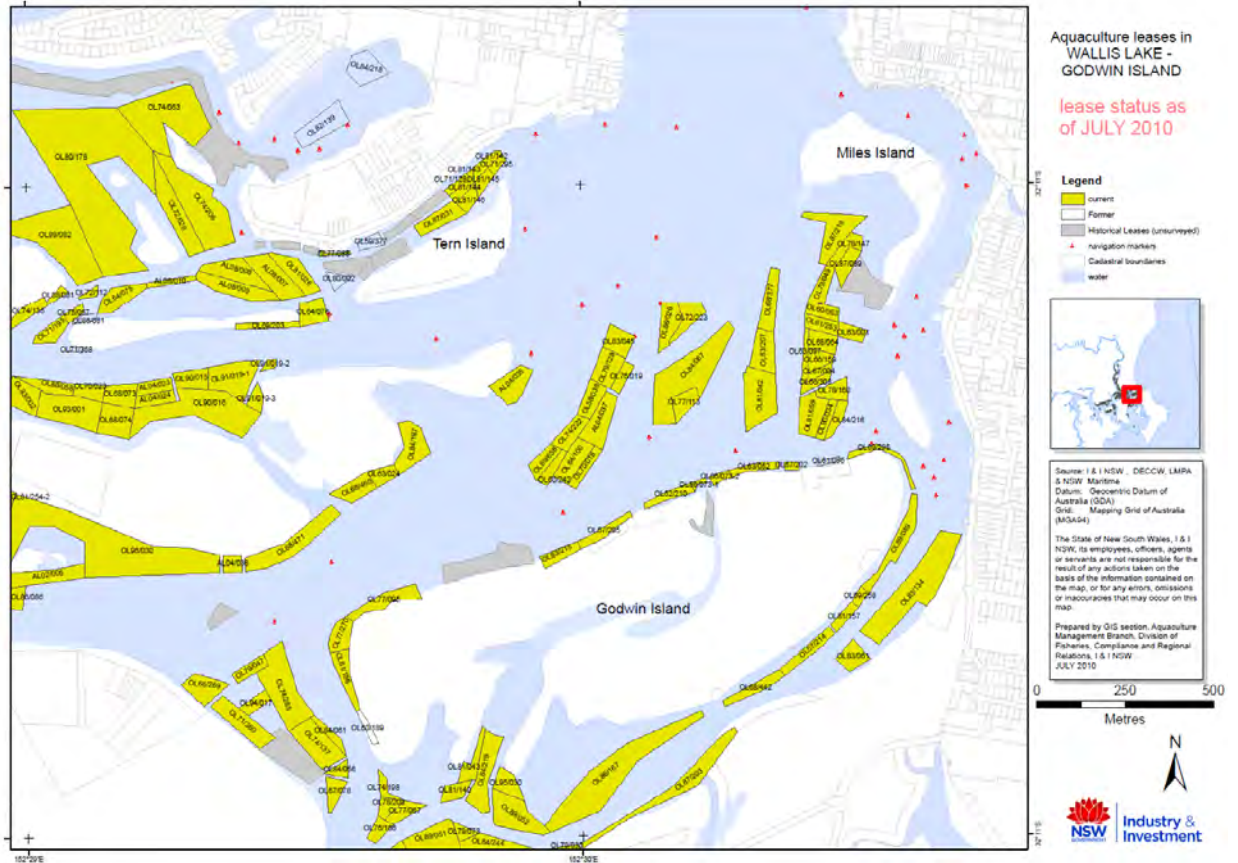


Figure 2.4 Lower Estuary Oyster Leases



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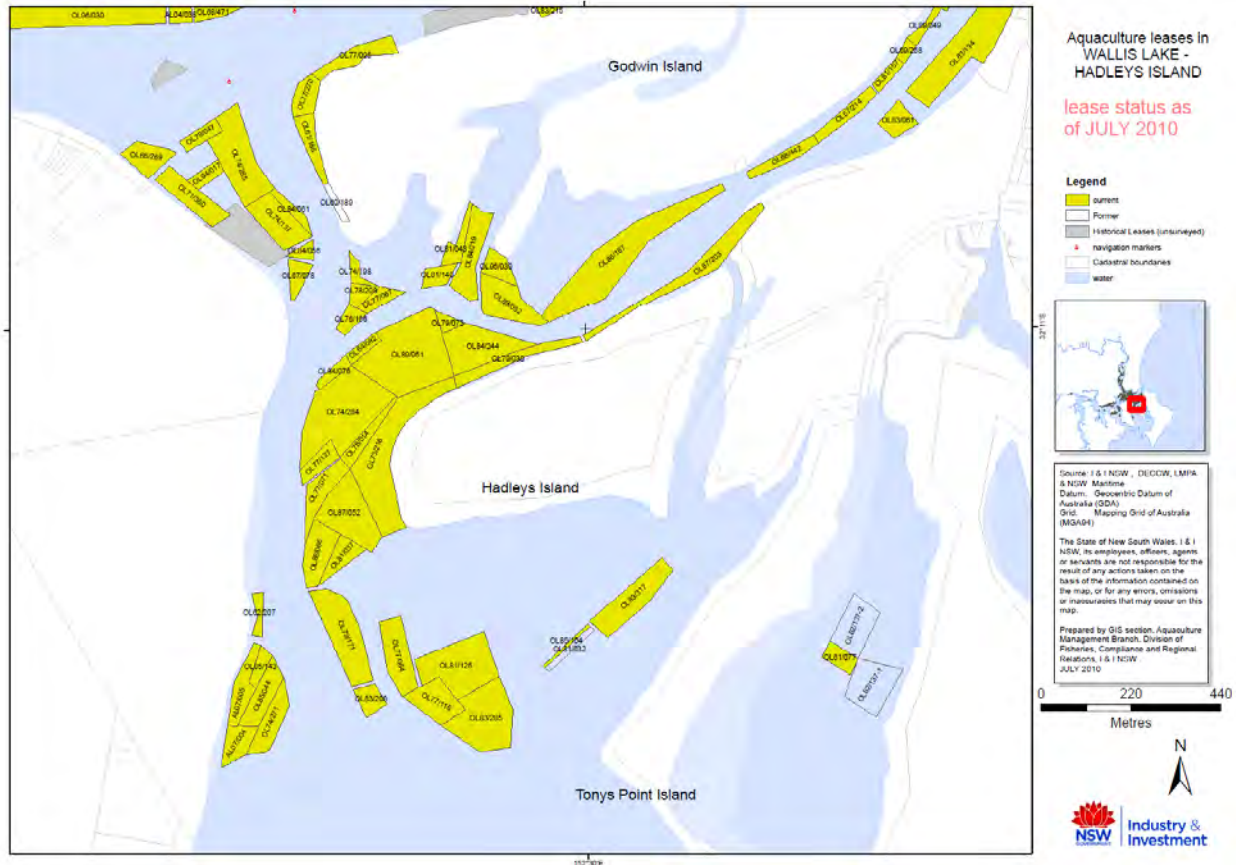


Figure 2.5 Oyster Leases near The Step

2.4 Marine/ Foreshore Ecology

2.4.1 General

WMA (1999) described the foreshores and marine ecology of Wallis Lake. The following is a summary of information included in the Estuary Processes Study. The Forster foreshores from the entrance mouth to the northern end of Pipers Bay have little or no terrestrial or aquatic vegetation in the urban areas, except for small patches of the seagrasses *Zostera* sub-tidally and some *Casuarinas* (sheoaks) along the foreshore. The islands are fringed by mangroves, with *Eucalypt* and *Casuarina* trees landward. Big and Tonys Island contain substantial areas of saltmarsh, and seagrasses as either fringing beds or large extensive beds. Dolphins, many fish, particularly luderick and bream and many species of seabird are commonly observed in this area.

The Tuncurry shoreline is generally unvegetated, with *Zostera* growing to about 500 m upstream of the bridge. The rest of the channel is bare sand, with kelp (*Ecklonia* sp.) and the algae *Sargassum* growing along the breakwater. Dolphins are commonly observed in the lower sections, as are luderick adjacent to oyster leases. Birds commonly observed include cormorants, ducks, swamp hens and whistling kites.



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Extensive sand flats exist on the seaward side of many of the small islands in the entrance channel, providing roosting areas for waterbirds. The reefs on the northern side of Wallis Island consist of long shelves with vertical walls dropping away from the intertidal zone to about 4 to 5 m water depths. The rocky shelf and wall areas are covered by algae, sponges, solitary corals and ascidians (e.g. *Pyura*, *cunjevoi*).

Sampling of fish and mobile invertebrates for the *Wallis Lake Estuary Processes Study*, identified 44 fish species (15 of these being of economic importance) and eight invertebrates. Dolphins are regularly observed around the islands, with birds commonly observed including pelicans, cormorants, herons, terns and white-breasted sea eagles. Osprey were observed above Cockatoo Island and Pied Oystercatchers were observed feeding amongst oyster racks.

WMA (1999) noted that, based on previous studies and work undertaken as part of the *Wallis Lake Estuary Processes Study*, the spatial extents of seagrass and algal beds were dynamic, changing naturally through time, as well as being influenced by anthropogenic changes to the shoreline and bathymetry of the lake. Studies of the macrobenthic fauna of the entrance channel found that it was generally depauperate compared to other areas of the lake, which was attributed to high sediment mobility.

2.4.2 The Step

A range of benthic infauna were identified in sediments collected from The Step and nearby channels as part of this Study. Species identified consisted mainly of various worm species, however, a small number of bivalves (e.g. clams), gastropods (e.g. whelks), amphipods and yabbies were also identified. The species richness and abundance were lowest in samples collected from unvegetated sandy areas on The Step and in the middle of the Hell's Gate channel.

2.5 Natural and Cultural Heritage

Seagrass, saltmarsh and mangrove communities mapped by DPI Fisheries are shown in **Figure 2.6**. Seagrass beds around the entrance consist of *Zostera*, with areas of *Posidonia* either side of The Step marine shoal and between Hadleys and Tonys Islands, Tonys and Big Islands and around Big Island. There are isolated beds of *Posidonia* within the large *Zostera* bed adjacent to the south-eastern section of Wallis Island. Seagrasses and mangroves are protected under the *Fisheries Management Act 1994*. In addition, Wallis Lake is thought to be the northern limit of *Posidonia australis* (Kirkman, 1997).

During field work for this Study, no seagrass was found on The Step. Dense beds of *Posidonia australis* were observed immediately south of The Step as well as sparse beds of *Z. capricorni*. Approximately mid-way between Hell's Gate and The Step beds of *Z. capricorni* (medium density) were present close to the Wallis Island shoreline.



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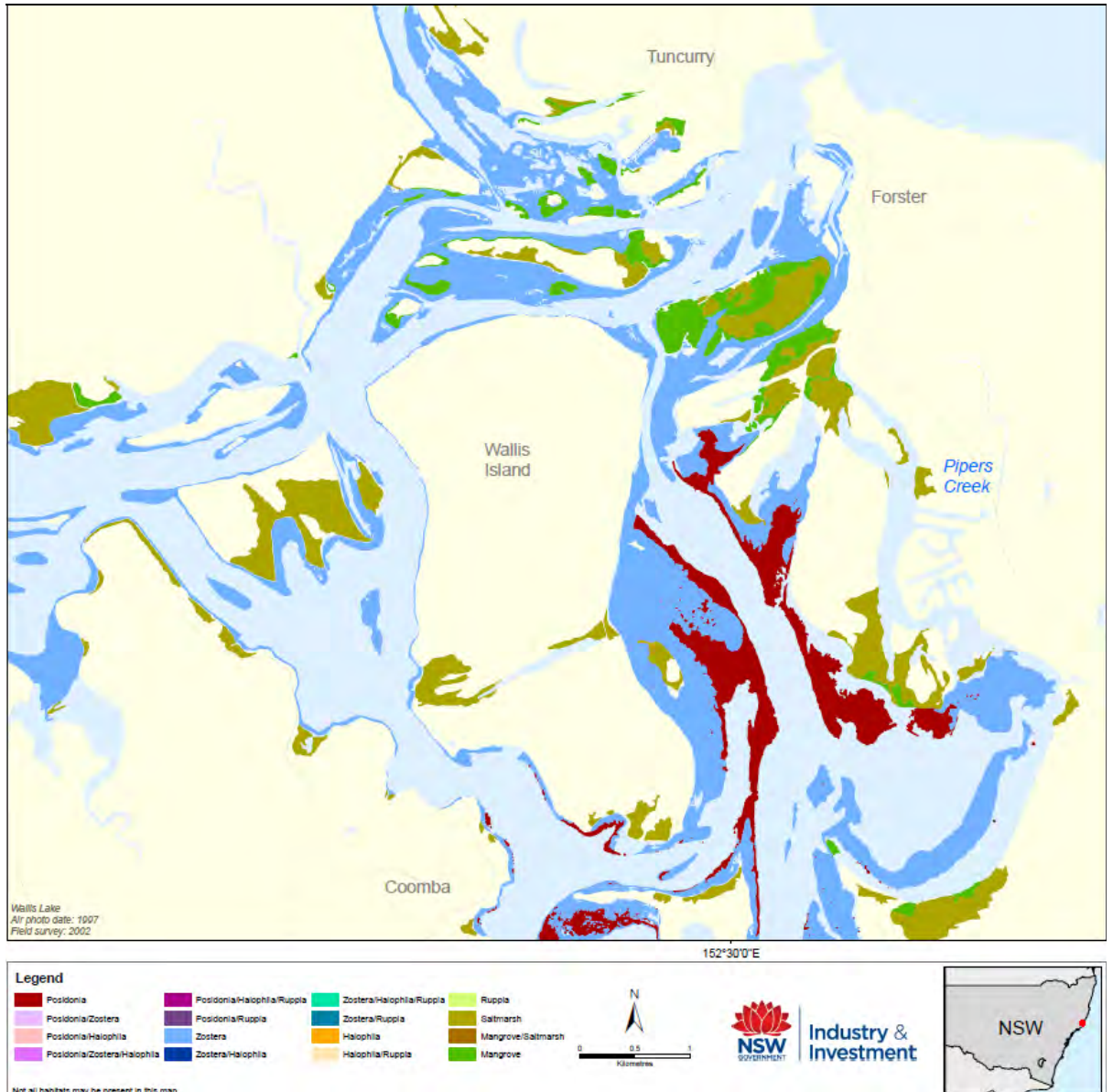


Figure 2.6 Aquatic Vegetation

A number of islands/ parts of Islands within Wallis Lake are protected under *State Environmental Planning Policy No.14 Coastal Wetlands* as shown in **Figure 2.7**. This includes Mather Island and surrounding smaller Islands, most of Miles and Godwin Islands and the south-eastern shoreline of Tonys Island.



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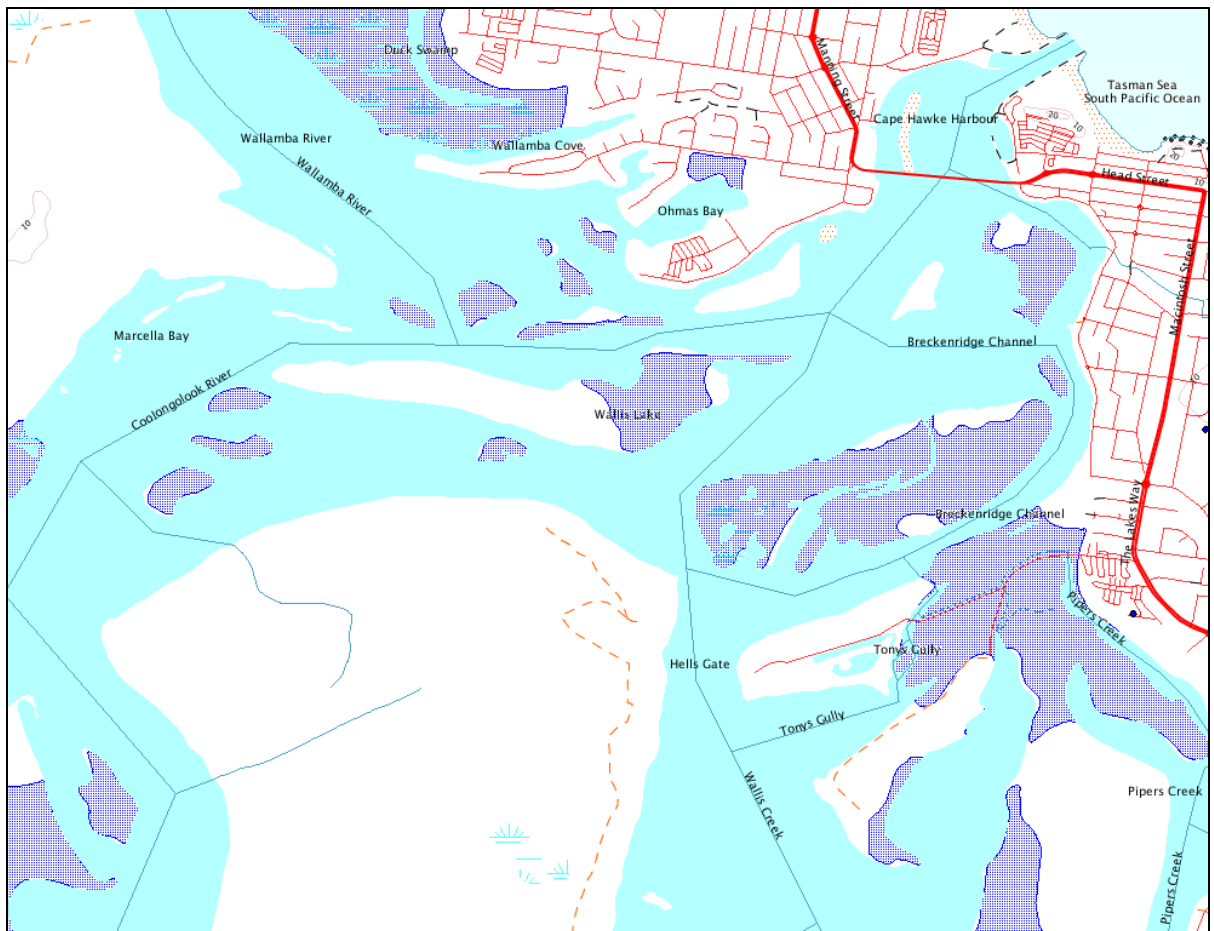


Figure 2.7 SEPP No.14 Wetlands

(source: nratlas.nsw.gov.au)

Wallis Island Nature Reserve covers the area outside the airstrip and private land on Wallis Island. It is a listed place on the Register of the National Estate.

A number of species listed under the *Commonwealth's Environment Protection and Biodiversity Conservation (EPBC) Act 1999*, *NSW Threatened Species Conservation (TSC) Act 1995* or protected under the *Fisheries Management Act 1994* are likely, or are known to occur in Wallis Lake. This includes species of turtles, dolphins, seals, pipefish and seahorses. In addition to these marine species, a number of migratory bird species visit (such as the Pied Oystercatcher and Little Tern) and are protected under the EPBC and TSC Acts as well as international treaties (Japan-Australia and China-Australia Migratory Bird Agreements, JAMBA and CAMBA). WMA (1999) noted that five Little Tern breeding sites had been located within the entrance channel of Wallis Lake, all on islands that have been created and were currently used for dredge spoil. NPWS (2003) noted that breeding sites at Forster were pre-1990.

There are no items listed in the heritage provisions of the *Great Lakes Local Environmental Plan 1996* within foreshore reserves or on the Wallis Lake Islands. WMA (1999) noted that 20 Aboriginal sites



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have been recorded for the Wallis Lake area along foreshores and in the coastal dunes. The majority of these sites are middens.

The foreshores around the entrance have been substantially disturbed by clearing, filling, bridge and training works. The islands within the lower estuary have also been subject to natural (e.g. changing shoaling patterns, erosion and accretion) and anthropogenic factors (creation by deposition of dredged spoil, previous dredged spoil disposal sites) accordingly this reduces the likelihood of other sites of cultural heritage significance being present in the study area.

2.6 Recreational and Commercial Activities

2.6.1 Beach, Foreshore, Island and Waterway Recreational Activities

Forster Main Beach and One Mile Beach are patrolled in summer, and during school holidays except in winter. Tuncurry/ Nine Mile Beach is not patrolled. Rips, often in combination with a deep trough can make the beach dangerous for swimmers. There is potential for good beach surf breaks under most swell conditions, and at the northern breakwater waves break over sand bars off the wall during big east to northeast swells. Numerous beach gutters are found along the length of the beach which are fished for tailor, bream and whiting, together with the northern breakwater for flathead and mullocky (Short 2006).

Four wheel drives are permitted on Tuncurry Beach (subject to a permit), apart from a 0.2 km length of beach in the north corner and a 0.8 km length at the south end. Vehicular access is from the end of Beach Street Tuncurry or from Hallidays Point to the north of the beach.

Swimming enclosures in and around Wallis Lake are the Forster Ocean Baths, the enclosure at Little Street Forster and the Tuncurry Rockpool.

The majority of vessels using the lower estuary are small to medium recreational boats and professional fishermen's powercraft.

Cruisers and larger yachts moor in the Forster Boatharbour and are generally restricted to the area upstream of the bridge, as it is too low to accommodate yacht masts (the clearance at each end of the bridge at high tide is approximately 6 m). Larger boats from Forster Keys and Pipers Creek may also be restricted to the main body of the lake due to navigation channel depths.

Most sailing and windsurfing is undertaken in the main, open part of Wallis Lake, although the area between Tern Island and the Forster–Tuncurry Bridge is also popular for windsurfers. The largest sailing boats on the lake tend to be trailer-sailors which can be launched from boat ramps. The main access points to the lower Wallis Lake estuary are the Tuncurry boat ramp off Point Road; the regional boat ramp at the Forster Marina; and the boat ramp near the Little Street baths. Public wharves/ jetties are also located at Memorial Park and John Wright Park, within Tuncurry and the Forster Boatharbour and Little Street baths.

The Great Lakes Sailing Club is located within Booti Booti National park on the The Lakes Way, south of Forster. The club has a small fleet of Taipan, Hobie, A-Class and assorted catamarans. The sailing season is from September to May with weekly racing on Sundays (www.yachting.org.au).



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Jelliffe (1998) noted that within Wallis Lake there was a preference for trailer-sailors, with the demand for small boat moorings decreasing. In addition, the demand for moorings for larger vessels capable of exploring the lake (e.g. houseboats and shallow draft cruisers) was not great in Wallis Lake as mooring opportunities are limited by shallow waters, exposure to wind and wave action and lack of easy access from the shore. Areas suitable for mooring expansion, such as Coomba Park, are generally isolated with negligible local demand (WMA 1999). However the demand for moorings for inshore and offshore professional fishing boats was strong (over 80 vessels are moored in the channel between Tern Island and Point Road, downstream to Bay Street, WMA 2005).

Recreational fishing is one of the main tourist attractions for the Wallis Lake area, with the most popular form being fishing from a boat in the lower estuary, main lake and the lower reaches of the Wallamba and Coolongalook Rivers. Bream, flathead, sand whiting and luderick are the main species targeted in the estuary. In summer the best fishing areas are the Regatta Grounds (flathead and whiting), The Cut (flathead), The Step (flathead), Wallamba River (flathead) and The Paddock (flathead and whiting). In winter, beam and luderick are most commonly found around oyster leases. Crabs are taken during most of the year and Breckenridge Channel is popular for prawning (using scoop nets) during the warmer months (WMA 1999).

Recreational deep sea fishing is also popular with catches including trevally, kingfish, mulloway, teraglin, Samson fish, tailor, snapper, flathead and bonito. Spearfishing is undertaken amongst the oyster leases but is excluded from the entrance area downstream of Tern, Mather and Godwin Islands. Crab traps, hoop nets and hand held prawn nets are also banned from this area (WMA 1999).

There are public amenities and picnic facilities on a number of island reserves within Wallis Lake including Long, Leon, Mather, Miles, Regatta, Tern and Wallis Islands. Barbecues and picnic tables are provided at most islands.

2.6.2 Tourism

A number of water-based tourism businesses are based at Forster–Tuncurry. This includes dive courses, snorkelling, surf schools, lake cruises, entrance and offshore cruises, dolphin watching trips, boat hire, kayak tours and kayak hire, lake and ocean fishing charters. Annual events include 'Commotion by the Ocean' at Tuncurry (January); Fishing Carnival, Chill Out Surf Classic and Great Lakes Viking Challenge at Forster in March; Club to Club Ocean Swim, Forster in April; and Wildcat Sailing Regatta, Forster and Bluewater Festival at Tuncurry in October (www.greatlakes.nsw.gov.au - brochure Things to do in the Great Lakes). The Great Lakes Sailing Club hosts the annual Wildcat regatta which attracts over 100 catamarans during the October long weekend (www.yachting.org.au).

As noted in **Section 1.6**, the Spirit, a large catamaran tourist vessel operates from Little Street, Forster. It travels down Breckenridge Channel, around Leon Island, across the top of Godwin Island, through The Step and then circumnavigates Wallis Island. The largest tourist vessel, the *Ameroo* cruises around the entrance channel and out to sea.

Houseboats are available for hire from Boatshed No.1 and are driven by the business operator from Breckenridge Channel across the top of Wallis Island and over the Western Step, from where they



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can be driven by tourists around the main body of the lake (the operator considers the downstream navigation channels too treacherous to be navigated by those hiring the houseboats).

Other hire boats are available from various operators including Blue Peter Boatshed (mainly hired for recreational fishing, kayaks can also be hired).

Tourism is one of the most important industries in the Great Lakes with almost one million visitors each year contributing around \$150 million to the economy (www.greatlakes.nsw.gov.au - brochure Doing Business Great Lakes Style).

2.6.3 Fishing and Oyster Farming

The Wallis Lake entrance from the north-eastern tip of Tern Island, south to the tip of Mather Island and then to mid-way along Godwin Island are closed to all forms of commercial fishing and recreational crab traps, hoop nets, hand-hauled prawn nets and spearfishing. From September to May, Wallis Lake is closed to commercial netting on weekends, but traps, prawn set-nets and prawn pocket nets are allowed.

WMA (1999) contains information on commercial fishing. The main commercial fishing techniques used in Wallis Lake are hauling and meshing. Nets catch a variety of species, including sea and sand mullet, bream, luderick, leatherjackets, tarwhine and sand whiting. Specific mesh nets are set for flathead (only south of an imaginary line drawn from Mosquito Island, east along the north face of Wallis Island and to the southern side of Hadleys Island) and blue-swimmer crabs. Other techniques include garfish bullringing (at The Step and Pipers Bay) and eel trapping.

Methods used to catch prawns in Wallis Lake include prawn hauling, seining and set pocket. Set-pocket netting for school and king prawns occurs in two areas: between the northern side of Wallis Island and Cockatoo Island and east across to the northern side of Hadleys Island into Breckenridge Channel; and on the northern side of Cockatoo Island, from the southern tip of the Wallamba River, across to the eastern tip of Tern Island. Crab pots are set throughout the body of the lake but this activity is more intensive within the tributaries.

Based on an examination of data from 1954/55 to 1992/93, WMA (1999) found that Wallis Lake generally supported the second largest fishery in NSW (fifth largest finfish fishery, WMA 2005), both in terms of volume and value, with a value of around \$2M in 1992/93. Wallis Lake was also the largest oyster industry and highest producer of blue swimmer crabs in the State.

The NSW oyster aquaculture industry is NSW's most valuable fishery, valued at approximately 30% of the State's total commercial fisheries production. Wallis Lake accounted for 20,828 bags (or nearly 29%) of the 2003/04 oyster production. Based on the value of the entire 2003/04 production, the value of the oyster industry to Wallis Lake producers was nearly \$11 million. The historical peak production for Wallis Lake was 28,841 bags in 1987/88 (DPI 2006).

Nearly all existing oyster leases in Wallis Lake are classified as priority aquaculture areas (358.3 ha) in the *Oyster Industry Sustainable Aquaculture Strategy* (DPI 2006). Only an area of 1.7 ha within Ohmas Bay is to be phased out. However, oyster leases between Tern Island and the Point Road foreshore are used only infrequently for spat collection (WMA 2005) and as noted in **Section 1.6** the leases at Hell's Gate (on the corner of Godwin Island) are little used due to fast flowing currents.



2.7 Sediment Characteristics

2.7.1 General

WMA (1999) identified three broad types of bed sediments in the Wallis Lake estuary:

- fluvial muds, sands and gravels
- reworked coastal sands
- beach and nearshore sands.

The fluvial sediments are of Holocene origin (last 6,000 years), originating from soils and rocks of the upper catchment, and contain a mixture of size fractions from clay and silt, to gravels and sands, and consist of lithic particles.

The reworked coastal sands originate from remnant beach deposits from the previous periods of high sea level. These sands tend to be well sorted, well rounded and mainly consist of quartz. They contain grains with an organic coating.

The beach and nearshore sands are similar to the reworked sands, but are of more recent origin, having been pushed up the continental shelf by the Holocene episode of sea level rise. These generally have a high shell content and an absence of organic coatings.

2.7.2 Tuncurry Beach

Sediment samples were taken from Tuncurry Beach as part of this Study. The sediments in the beach area were 100 % sand, with a d_{50} (median grain size) of approximately 0.30 mm.

2.7.3 Navigation Channels

Sediment samples were taken in the entrance channel as part of this Study and were found to be 97% sand, with a d_{50} of approximately 0.35 mm.

Sediment analysis for Tuncurry Channel showed predominantly medium, grained (0.25-0.5 mm) sand with some shell matter but negligible fines and very low organic content. Acid sulphate soils (ASS) screening and subsequent testing indicated that there were no actual or potential acid sulphate soils present (Great Lakes Council 2010a). Sediment analysis within Breckenridge channel (immediately upstream of bridge) in 2011 and within the "paddock" area in 2012 identified similar results (personal communication, G. Tuckerman, GLC, 2013).

For Pipers Channel, results from acid sulphate soil (ASS) screening and subsequent testing indicated some significant ASS potential within the dredged material. However the sediments had significant buffering capacity due to the presence of shell grit and fine calcium carbonate fragments, although it was thought this buffering capacity may be confined to a specific layer (or layers) within the sediment. The calcium carbonate content varied from 0.4% to 6.6% in the samples analysed. The sand had a very low organic content and some shell matter (Great Lakes Council 2010b).



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Sediment samples from The Step marine dropover (collected as part of this Study) consisted predominantly of sand with small amounts of silt (2% or less) and clay (1% or less). Within Wallis Lake upstream of The Step, two samples were found to be 94 and 95% sand, while a third consisted of 64% sand, 20% silt and 15% clay. Two samples within the navigation channel downstream of The Step were 94% and 98% sand. Generally, sediments at The Step can be described as 94 to 98% sand, with a d_{50} of approximately 0.30 to 0.35 mm.

2.7.4 Dredged Sediment Stockpiles

Sampling of stockpiled dredged material on Tern Island found the material to be rounded, very well sorted (around 0.30 mm in size), medium-sized beach and nearshore marine sands with low fines content and a variable (low to high) shell content. Stockpiled material was tested and found not to contain Acid Sulphate Soils (ASS). Salt levels were low due to the long period of stockpiling (i.e. leaching of salt by rainwater). A visual inspection of other lower estuary deposition sites indicated sand of a similar nature. Sands dredged from the lower Wallamba Broadwater, such as at Rest Point or The Cut, also appeared similar but had higher silt content. This would also be expected for oyster leases which tend to collect fine sediments and organic matter (WMA 2005).

PWD (1988) reported on sand samples analysed by Blue Metal & Gravel (BMG) from the former disposal areas on Tern Island, Tuncurry Point and the area adjacent to Barclays oyster depot. Samples were taken from both navigation channel and oyster lease dredge spoil. The spoil was mainly sand with a relatively high shell content. The sand was considered suitable for fill, however, only 30 to 40% was found satisfactory for use in structural concrete.

Readymix also analysed sand samples from former disposal sites and considered that the spoil would be suitable for fill, mortar sand and concrete. The results indicated a sand of high density, low water absorption, acceptable organic content and satisfactory grading. The sodium sulphate soundness and shell content tests were in progress at the time the 1988 PWD report was written.

2.8 Coastal and Estuarine Processes

2.8.1 Impact of Entrance Training and other Works

Neilsen and Gordon (1986) estimated a net northerly littoral drift of 20,000 m³ per annum along Seven Mile Beach/ Forster beaches and Tuncurry/ Nine Mile Beach. At the Wallis Lake entrance prior to the early 1960s, an ebb tide (outflowing) channel existed adjacent to Tuncurry with a flood tide (inflowing) channel adjacent to Forster. A large middle ground shoal existed between these channels (WMA 1999).

Prior to construction of the Forster–Tuncurry Bridge in 1961, a dredged channel was maintained across the entrance for the vehicle ferry connecting the two towns. Dredged sand was mainly deposited on the middle ground shoal and other islands in the lower estuary area.

Following construction of the northern breakwater and extension of the southern breakwater in 1966, flows were concentrated, with the inflowing tide directed towards the middle ground shoal, which rapidly eroded. There was significant scouring of the lower estuary area channels, with a new



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channel developing between the original Tuncurry and Forster channels, more in line with the entrance (WMA 1999).

As the flood tide delta gradually eroded, the southern channel moved slowly northward from Breckenridge Channel towards the Forster–Tuncurry Bridge. This created problems with undermining of the bridge pile supports. Also, where the southern channel used to meet Breckenridge Channel, a shoal formed restricting navigation (PWD 1988). The Forster–Tuncurry Bridge does not significantly reduce the waterway area of the entrance channel and so does not have a major impact on estuarine hydrodynamics. The major loss of sediment surrounding the middle spans of the bridge over the last 30 years is due to the concentration of flows by the northern breakwater and the cessation of vehicle ferry dredging (WMA 1999).

From available aerial photography, the pattern of erosion of the shoal suggested a net sediment movement towards the ocean and onto the entrance bar. Most of the sand that moved onto the entrance bar was moved onto the beaches north and south of the entrance by waves and currents and trapped behind the breakwaters. Based on aerial photography and hydrographic survey data, the volume of sand lost from the entrance/ middle ground shoal area was around 700,000 m³, which is a similar volume to that estimated to have been deposited on the beaches (this movement has now largely ceased, but the process resulted in a period of high net sediment movement out of the estuary) (WMA 1999).

Investigations in the early 1980s suggested that construction of the northern breakwater/ training wall in 1966 resulted in major flow scour of the middle ground shoal. However, aerial photography from 1937 and 1952 clearly shows inflowing (flood tide ramp) scour of the shoal. WMA (1999) therefore concluded that shoal build-up in the 1950s and 1960s was the result of ongoing dredging for vehicle ferries (prior to construction of the Forster–Tuncurry Bridge). Erosion of the shoal after dredging ceased and the breakwater was constructed was therefore more a function of the sand sink created on the ocean beaches, rather than increased entrance efficiency.

Following construction of the northern breakwater there was some evidence to suggest that tidal ranges in the lake increased, however WMA (1999) noted that it was not clear whether this was totally due to the construction of the northern breakwater, or whether data/ analysis error and/ or channel dredging, particularly at The Step, were contributing factors. WMA (1999) estimated tidal exchange in the lower estuary to be less than one week.

Past dredging, entrance training works, reclamation and oyster lease development have all substantially changed the morphology of the entrance area with the general result that there are now more distinct channels/ shoal areas. Large quantities of beach and nearshore sands have been stabilised on estuary islands and the beaches beside the breakwaters. Oyster lease development has also trapped sediments and stabilised channels in some areas, although the infilling of leases continues to be an issue for oyster producers.

Dredging a channel between Forster Keys (developed in the mid-1970s) and Pipers Bay increased flows into Pipers Creek (which was previously substantially cut off from the main lake) and diverted flows away from the upper Pipers Bay foreshore area. This increased tidal flushing of Pipers Creek and Forsters Keys but restricted flows in the upper bay area. As a result, catchment sediments remain in the upper bay and extensive seagrass growth has occurred. Subsequent to the opening of



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the new channel, the existing small northern channel between the Pipers Creek and Breckenridge Channel was substantially closed by construction of a road to Tonys Island and by oyster industry fill. This somewhat reduced the flushing benefits to Pipers Creek and Forster Keys achieved through dredging the new southern channel.

2.8.2 Sediment Movement

The lower estuary (or the marine delta) is by far the main area of sediment movement in the lake. Sediment dynamics in this area are dominated by tidal flows which are constantly moving the beach and nearshore sands around, into and out of the entrance area, in response to changes in tidal conditions and littoral zone processes (WMA 1999).

Flood flows are not considered a significant influence on channel scour as PWD (1988) found that only one very large flood in 1929 severely eroded the entrance channels. A local oyster farmer reported that significant accretion occurred at the junction of the Wallamba River and the lake during the severe floods of 1954.

During each tidal cycle marine sand is scoured from the entrance and deposited on the entrance bar. Some of this entrance sand and some nearshore sand from the entrance bar then moves back into the estuary on subsequent tides. WMA (1999) estimated the gross annual movement of sediment into and out of the entrance as exceeding 200,000 m³ per annum, with only a small net movement of sediment out of the estuary. Based on an assessment of channel and beach morphology from aerial photography, as well as tidal flow and velocity data, sediment movement between the entrance bar and the middle ground shoal was assumed to approach equilibrium.

Sediment movement upstream of the immediate entrance channel also appeared to be reasonably balanced, with a comparatively small net upstream movement. By Godwin Island (2 km from the entrance) gross sediment movement dropped to less than 30,000 m³ per annum. At The Step and the other marine delta dropovers, the estimated rate of sediment movement was only a few thousand cubic metres per annum (WMA 1999).

WMA (1999) noted that significant channel and bed movements and some bank erosion continue to occur. Movement of sediment into dredged and oyster lease areas and over The Step is evident. Erosion is a result of ongoing channel changes from natural movements on the marine delta plus past entrance works, dredging, reclamation and oyster lease development. The main erosion site is along the northern side of Mathers Island where there is a high bank of dredged sand eroding over a distance of 200 m. PWD (1988) thought it likely that ebb flows from the navigation channel, dredged past Tuncurry Point in the 1970s, was exacerbating shoreline erosion at Mather Island. Aerial photography from 1937 shows that the basic shape of Tern Island has essentially remained the same. The reason for the comparative stability of the island foreshores (as well as foreshores at the ends of Point Road and Rest Point) was thought probably due to the presence of a sandy clay layer at and below mean to low tide level (WMA 2005).

In terms of hydrodynamic impacts, WMA (1999) considered that dredging works carried out in the late 1960s and early 1970s were probably the most significant. This included:

- dredging in the upper reach of Breckenridge Channel



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- dredging around Hadleys and Wallis Islands
- dredging at The Step
- ongoing dredging around Cockatoo Island the The Cut
- dredging to form a second eastern channel into the Wallamba River.

Earlier (1950s) excavation of The Cut into the Wallamba River and The Mud Cut in the lower Wallamba River would also have had a significant effect on flows in the Wallamba River.

More recent dredging in Wallis Lake, associated with the maintenance of flows to oyster leases, would be expected to have had only a localised impacts on flow distribution. Flow patterns within the lower estuary have also been affected by oyster farming activities, particularly oyster racks which slow currents, encouraging sediment deposition. This in turn has led to increased flow concentrations and velocities in the channels between leases.

2.8.3 Climate Change Implications

The principal impact of climate change on Wallis Lake will be associated with the predicted rise in mean sea level. DECCW released the *Sea Level Rise Policy Statement* in 2009 which adopts a sea level rise planning benchmark for the NSW coastline based on the upper limits of the most credible national and international projections. The planning benchmarks are an increase above 1990 mean sea levels of 0.40 m by 2050 and 0.90 m by 2100.

Another potential outcome of climate change is a possible change in the frequency and intensity of storm events. Modest to moderate increases in average and maximum cyclone intensities are expected in the Australian region in a warmer world. However, cyclone frequency and intensity are strongly associated with the El Niño/ Southern Oscillation (ENSO) phenomenon. How this phenomenon will vary in a warmer world is currently unknown.

Mid latitude storms have been predicted to increase in intensity but decrease in frequency with global warming (CSIRO 2002), due to a reduction in equator to pole temperature gradients. However as with tropical cyclones, climate modelling at present lacks the resolution to accurately predict changes associated with global warming.



3 PREVIOUS DREDGING AND DISPOSAL SITES

3.1 Navigation Channel Dredging Late 1960s to Early 1970s

As noted in **Section 2.8.2** WMA (1999) identified that probably the most significant dredging work was undertaken in the late 1960s and early 1970s to open up and stabilise channels around the lower estuary, which included dredging in the upper channels of Breckenridge Channel and around Hadleys Island, Wallis Island and The Step as shown in **Figure 3.1**.

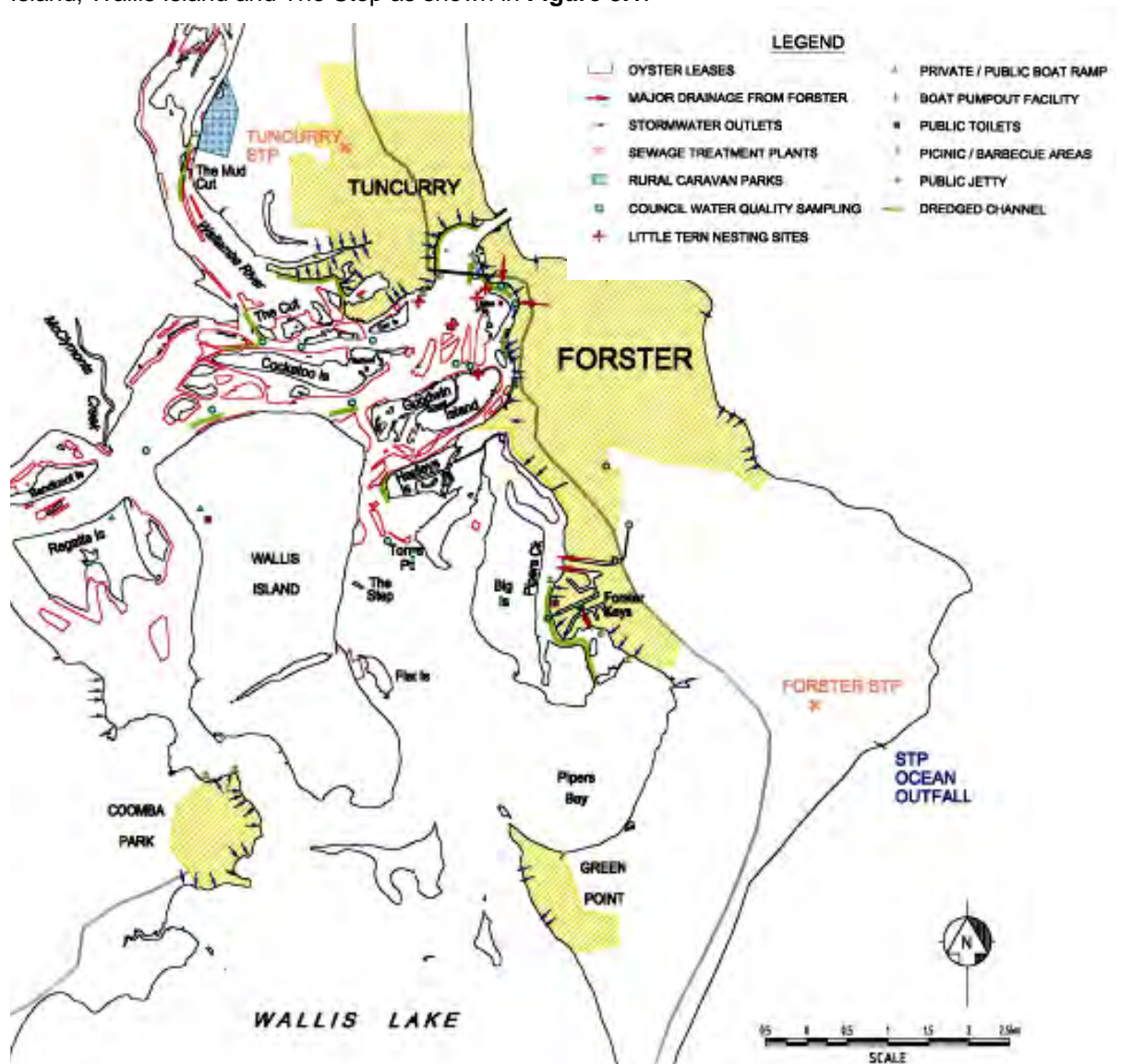


Figure 3.1 Estuary Infrastructure and Dredging Locations late 1960s to early 1970s
(Source: WMA 1999)



3.2 Navigation Channel Dredging 1971 to 1988

PWD (1988) documented the location and volume of material dredged from navigation channels and oyster leases between 1971 and 1988 (see **Table 3.1**), as well as sediment removed from oyster leases (and disposal sites), see **Section 3.4**.

Table 3.1 Navigation Channel Dredging 1971 to 1988 (PWD 1988)

Date	Location	Estimated Dredged Volume (m ³)
Jan 1971	Devil Rock	6,939
"	East of Miles Is	724
"	"	122
"	Tuncurry Channel	2,708
"	Forster Channel	5,265
"	Tuncurry Channel	4,298
"	West of Miles Is.	5,235
74/76	South of North Head	1,604
"	SW of North Head	3,493
"	Tuncurry Channel	1,410
"	"	3,438
"	Forster Channel	3,392
"	NW of Miles Is.	11,685
"	East of Taren Is.	4,070
"	North of Godwin Is.	7,855
"	"	4,810
"	East of Mather Is.	3,477
"	East of Long Is.	3,363
"	South of Cut Is.	5,131
"	"	4,290
"	Breckenridge Channel	9,080
"	SE of Mosquito Is.	6,207
Jan 1978	West of Tern Is.	7,827
"	Tuncurry Channel	29,157
Sep 1982	Tuncurry Channel	17,119
Jun 1983	West of Wallis Is. (The Step)	5,678
Jun 1984	North of Cut Is.	3,490
"	Breckenridge Channel	8,631
"	Tuncurry Channel	3,548
Total		174,046



3.3 More Recent Navigation Dredging and Disposal Sites

About 10 years ago approximately 20,000 m³ of sand was dredged from Tuncurry Channel to maintain navigation depths to the boat ramp (Great Lakes Council 2010a). As noted in **Section 1.5.1**, in 2010 approximately 17,000 m³ and 4,000 m³ of sediment was dredged from Tuncurry and Pipers Channels respectively.

For the Tuncurry Channel dredging, Point Road Reserve and Fazio Park were identified as suitable temporary disposal sites (Fazio Park was later selected). For Pipers Channel, dredged material was transferred to Forster Keys Foreshore Reserve and then utilised for fill for a planned sports field at Lakes Estate (South Forster playing fields).

As noted in **Section 1.6**, sand is removed from the Tuncurry Rockpool on a regular basis. GCC indicated that the volume of sand removed from the rockpool is generally in the order of 500 cubic metres and this occurs between two and three times per year (pers. comm. David Bortfeld). The sand is removed using a suit of trucks, dozer and loader and the final destination of this material varies.

3.4 Oyster Lease Dredging and Disposal Sites 1976 to 1988

PWD (1988) reported on oyster lease dredging and associated disposal sites between 1976 and 1988 (see **Table 3.2**) and further dredging (see **Table 3.3**) pending the outcomes of the 1988 report (total of 245,820 m³ of material). A number of oyster lease dredging proposals were also refused between 1976 and 1988 (totaling 97,500 m³ of material) for dredging around Bells, Cut and Durands Islands, dredging adjacent to parts of Mosquito and Hadleys Islands, an area within The Paddock and lease areas between Cockatoo and Wallis Islands.

Oyster lease areas dredged included leases along Long Island, lease areas adjacent to Cockatoo and Mather Islands, southern lease areas in the paddock near Leon Island and lease areas within Hell's Gate/ the channel leading to The Step. Disposal sites included Tern Island, Tuncurry Point Reserve, Cockatoo Island, Godwin/ Mathers Islands and Wallis Island. The PWD table reproduced below referred to Taren Island, it is assumed this means Tern Island.

Table 3.2 Oyster Lease Dredging 1976 to 1988 (PWD 1988)

Applicant	Farm	Year	Estimated Volume (m ³)	Disposal Site
Barclay G	74.122	1986	1000	Cockatoo Is.
"	72.329	1984	12800	Lands Area
Barclay NF	69.233	1980	10000	Taren Is. [Tern Is.?)
"	64.75	?	5000	"
Barclay PL	55.47	1984	30000	"
Cain N	79.30	1982	700	Hadley Is.



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Carr JC	66.326	1986	2000	Cockatoo Is.
Coombes L	81.42	1983	750	Godwin Is.
Coxson J	81.140	1982	1000	Hadley Is.
Degioia B	56.65	1979	2000	Cockatoo Is.
Fazio B	59.361	1977	7000	"
McIntosh B	81.59	1984	8500	Godwin Is.
McPherson CL	75.226	1979	2294	Oaky Is.
Moran H	69.639	1982	1200	Mathers Is.
Moran ME	74.271	"	1500	Wallis Is.
"	74.284	1984	23000	Hadleys Is.
"	74.158	"	3000	Cockatoo Is.
"	69.640	1978	2400	Mathers Is.
"	74.285	"	7000	Godwin Is.
"	45.77	1976	7000	"
R & T Oysters	81.26	1984	2500	Taren Is. [Tern Is. ?]
Ralston D	79.171	1983	1500	Hadleys Is.
Ralston RM	86.78	1986	1500	Mather/Godwin Is.
Ravell K	61.27	1985	5000	Godwin Is.
Applicant	Farm	Year	Estimated Volume (m³)	Disposal Site
Tidal Oysters P/L	70.235	1978	2500	Cockatoo Is.
Verdich M	72.11	1985	3000	?
"	77.127	1984	3000	?
"	72.11	1979	3340	Cockatoo Is.
"	68.73	1980	1000	"
Barclay G	82.107	1985	2000	Wallis Is.
"	60.18	1984	3500	Cockatoo Is.
Total			157,000	



Table 3.3 Oyster Lease Dredging Applications that were pending completion of the Strategy

Applicant	Farm	Year	Estimated Volume (m ³)	Disposal Site
Barclay G	74.63	1987	20000	Caravan Park
“	74.137	“	20000	Cockatoo Island
“	76.112	“	4800	Wallis Is.
“	74.138	“	5000	Private Land
“	83.45	1988	2720	Taren Is. [Tern Is.?)
Latimore GK & RH	84.216	“	1000	Not Given
“	78.160	“	1500	Not Given
Dent A	81.254	“	10000	Cockatoo Is.
Barclay G	70.23	“	4000	Long Is. or Cockatoo Is.
“	74.206	“	6800	Tuncurry Point
“	71.205	“	13000	Wallis Is. – Private Property
Total			88,820	

3.5 Summary of Past Dredging and Disposal Sites

WMA (1999) estimated that since 1970 over 200,000 m³ of sand had been dredged from channels for navigation purposes, with a similar volume for land reclamation/ canal development and a similar volume for the oyster industry (i.e. approximately 600,000 m³ in total). Anecdotal evidence indicates that prior to the latest dredging of Tuncurry and Pipers Channel in 2010, no dredging has been undertaken in Wallis lake for over 10 years, and hence the WMA estimates are still relevant. Accordingly an average amount of material dredged between 1970 and 2000 is 20,000 m³.

The following is a summary of dredging and reclamation works from WMA (1999).

Some of the main channel dredging sites since 1970 have been:

- Point Road – Jonnell Park channel into Wallamba River
- Tuncurry Channel
- Breckenridge Channel



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- the drop offs (including The Step)
- Forster Channel (around the bridge)
- around Cockatoo and Mather Islands
- The Cut and the Mud Cut in the Wallamba River.

Many of these channels were dredged more than once (PWD 1988). The main disposal sites were:

- Tern Island
- Godwin Island
- Cocktoo Island
- Tuncurry Point
- Forster foreshore near Godwin Island.

Most of the oyster industry dredging was undertaken around Cockatoo, Mather and Godwin Islands with the disposal sites being the islands and foreshores around the entrance.

The main land reclamation/ canal development projects occurred in the 1970s. The Tuncurry-Jonnell Park development involved around 100,000 m³ of dredging and landfill and ultimately included the channel to Jonnell Cove. Forster Keys and the Pipers Creek channel development involved over 100,000 m³ of dredging and reclamation which opened up Pipers Creek as noted in **Section 2.8.1**. The Forster Boatharbour involved a lesser volume for the expansion of boating facilities (WMA 1999).

WMA (2005) noted that dredged sand had been deposited on Tern Island for over 80 years as evidenced by historical aerial photographs, with records indicating that the last substantial deposition occurred in the late 1970s, with minor deposition in the 1990s.

3.6 Dredging Requirements and Potential Disposal Sites (PWD 1988)

3.6.1 Dredging Volumes

The 1988 PWD report provided five year estimates for navigation channel dredging (see **Table 3.4**), oyster lease dredging (see **Table 3.5**). Potential disposal sites were also indicated, see **Table 3.6**.

Table 3.4 Estimated Navigation Channel Dredging Requirements 1988 to 1993 (PWD 1988)

Location	Anticipated Dredging Frequency	Estimated Total Dredging Volume (m ³)
Tuncurry Channel	Once	15,000
Road Bridge Shoal to Breckenridge Channel	Twice	16,000
Wallamba Channel (<i>opp. Tern Island</i>)	Once	5,000



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The Cut	Once	10,000
The Step	Once	4,000
Dropover on Wang Wauk Creek (<i>adj. to Mosquito Island</i>)	Once	15,000
Total		65,000

Table 3.5 Estimated Future Oyster Lease Dredging Requirements 1988 to 1993 (PWD 1988)

Applicant	Farm	Estimated Dredge Volume (m ³)	Disposal Location
Moran Bros.	74.284	5000	Nino Lani – Private Land
“	74.271	1000	South of Farm
“	74.285	1200	Knox Greenway – Private Land
Verdich M	83.207	4000	Godwin Is.
Barclay G	84.229	14800	Nino Lani – Private Land
“	78.17	1700	“
Ohama D	84.172	35000	Caravan Park
Gralton J & B	80.178	63000	“
Cain N	81.37	2000	Not Given
Cleft R	66.269	1500	“
Applicant	Farm	Estimated Dredge Volume (m ³)	Disposal Location
Kenhurse Oysters	74.151	7000	“
“	76.196}	18000	“
“	61.55}		“
Ravell K	75.216	10000	“
“	69.540	15000	“
Snowden W	71.357	5000	“
“	69.535	1600	“
“	77.116	7500	“
Tidal Oysters P/L	70.189	5500	“
“	78.44	13000	“



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“	80.20	2000	“
Wallis Lake Oyster Co	77.153	1500	“
Barclay G	64.73	4500	Regatta Is.
Broadley J	55.221	14000	Taree Street
Lauff SE	79.73	2000	Hadleys Is.
Ravell K	64.253	15000	Coomba
Total		250,800	

The future dredging requirements between 1988 and 1993 totaled approximately 315,800 m³, with 120,700 m³ of this proposed for disposal on private land. This equated to an average of 63,000 m³ over the five year period (13,000 m³ for navigation dredging). However as noted in **Section 3.5**, more recently WMA (2005) estimated that on average a total of some 20,000 m³ per year of sediment had been dredged over the past 30 years to keep the channels and leases open. This volume was also indicated by Council as representing future navigation channel dredging requirements for the purposes of investigating the feasibility of a permanent pipeline for disposal of dredged material on Tuncurry Beach.

3.6.2 Potential Disposal Sites

PWD (1988) identified acceptable disposal sites in consultation with the then NSW Fisheries, National Parks and Wildlife Service (NPWS) and the Department of Planning (DoP) as shown in **Table 3.6**.



Table 3.6 Acceptable Disposal Sites (PWD 1988)

Site Number	Location	Proposed Height of Fill (m)	Estimated Capacity (m ³)
1	Island downstream of road bridge (Tuncurry side – bridge piles/ Co-op Island)	2	50,000
2*	Island/ shoal upstream of road bridge (Tuncurry side – downstream of Tern Island and opposite Boatland Marine)	1.5	26,000
3	Tern Island	1.5	48,000
4	Shoal between Tern and Miles Islands	2	70,000
5	Godwin Island (north-eastern end)	3	50,000
6	Adjacent to Barclay’s Oyster Depot	2	20,000
9	Tuncurry Point	2	30,000
10	Cockatoo Island (former disposal sites only involving amalgamation of four previous fill sites on western half of island)	2	44,000
11	Private Land adjacent to The Cut (no estimate made in PWD 1988)		
15**	Tuncurry Beach	2	30,000
17	Godwin Island (southern end)	2.5	38,000
Total			406,000

*NPWS preferred that no disposal occurred on site 2 (island upstream of bridge and downstream of Tern Island) because it was considered a heavily used bird wader site, however it was recognised that disposal in other areas would create additional, compensatory inter-tidal habitat.

**NPWS identified a nearby Aboriginal site which may have to be relocated to allow disposal in this area at Tuncurry Beach.

A description, by PWD (1988), of sites identified as being suitable for use as disposal sites and considered further in this Study, is provided below. Disposal areas identified by PWD (1988) as being suitable for commercial operations (i.e. stockpiling sand for commercial uses) were Tern Island, area adjacent to Barclay’s oyster depot and Tuncurry Point.



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Tern Island

Tern Island consists of about 4 to 5 m of dredge sand above mean sea level. On the north western shores of the island a tree screen obstructs any view of the sand mound from the residences in Tuncurry Point Road. A disposal operation in the mid-1980s raised the western end of the island by 1.5 to 2 m above the general surface level of the island. PWD (1988) estimated that there was potential to raise the remainder of the island by at least 1.5 m, without adverse impacts on residents in Tuncurry Point Road.

Tuncurry Beach

This involved construction of dunes and filling of a swale to accommodate an easterly expansion of the caravan park (PWD 1988).

3.6.3 Other Disposal Sites Considered

Additional sites were assessed by PWD, NPWS, Fisheries, DoP and Lands but there were objections to the use of these sites by one or more government agencies, as noted in **Table 3.6**.

Table 3.6 Rejected Disposal Sites – Wallis Lake (PWD 1988)

Location	Estimated Capacity (m ³)	Comments
Bay downstream of Mather Island	37,000	Narrow spit extending downstream of Mather Island eroded by tidal flow – periodic placement of dredged spoil on southern side which would be gradually eroded away. Possible objections from oyster farmers based on Mather Island, however, alternative may be a breakthrough of the sand spit as tidal flows completely erode the spit. <i>Note that the Oyster Farmer's representatives have suggested this as a disposal site, see Section 1.6.</i>
Mather Island	50,000	Rejected because it would entail filling of saltmarsh/ SEPP No.14 wetland/ area of particular ecological merit
Cockatoo Island	80,000	Disposal on undisturbed sites at western end of island would impact on wetland/ palm forest mosaic and littoral rainforest
Deepwater (north-west of Mosquito Island upstream of Wallamba Channel dropover)	195,000	Water depth about 9 m. Fisheries considered the deepwater habitats sufficiently unique to justify protection of habitats.



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Location	Estimated Capacity (m ³)	Comments
Between Wallis and Mosquito Islands (<i>Western Dropover</i>)	38,000	Formation of a sandspit to constrain tidal flows and increase tidal velocities through the shoals to increase scour of the navigation channel through the dropover so that it was self scouring. This would require protection of the outer edge of the shoal by, for example, timber groynes. Fisheries disputed that this would have little impact on downstream hydraulic and sediment transport behaviour and that ecological issues needed to be investigated.
Deepwater (south of Tonys Point and west of Big Island upstream of The Step dropover)	173,000	Water depth about 5 m (small scale disposal onto the downstream slope in a deepwater hole was considered acceptable subject to further investigation). Note that this would smother <i>Posidonia</i> seagrasses.
Deepwater (between Regatta Island and Wallis Island)	42,000	Water depth about 5 m. Fisheries considered the deepwater habitats sufficiently unique to justify protection of habitats.
Ohmas Bay	64,000	The bay is considered to have particular ecological merit.

After PWD 1988



4 NAVIGATION CHANNEL DREDGING AND DISPOSAL OPTIONS

4.1 Navigation Channel Dredging

As noted in **Section 1.6** NSW Maritime and the Wallis Lake Fishermen's Co-operative considered that any dredging of The Step should be of the naturally occurring western channel currently used by vessels, including *The Spirit* for tourist cruises in Wallis Lake. Although the Free Spirit Cruises operator noted some deepening of the western channel in recent years, only one starboard navigation channel marker was recently reinstated by NSW Maritime, as depths were too shallow to install the proposed second starboard marker. Also, as noted in **Section 1.1**, The Step dropover has been prograding and during field work for this Study it was noted that the dropover was encroaching on *Posidonia* beds, as reported in the Estuary Processes Study (WMA 1999).

The Wallis Lake houseboat operator identified the Western Step on the northern side of Wallis Island as a priority for dredging, as this is the route taken by houseboats to the main body of Wallis Lake. This route is also taken by *The Spirit* when circumnavigating Wallis Island and was identified by Boatland Marine as an area that had silted up.

Several stakeholders mentioned shallowing or the need for dredging in the area between Cockatoo/ Mather Island and Godwin/ Wallis Island, e.g:

- dredging needed of Boomers Channel, north of the channel that leads to The Step (Forster Keys Progress and Ratepayers Association)
- sand built-up on shoals between The Paddock and Mather Island (Free Spirit Cruises)
- dredging needed on the northern side of the oyster leases on the north-eastern corner of Wallis Island (Oyster Farmer Association).

Some shallowing of this area is evident from a comparison of the 1998 and 2010 hydrographic surveys.

It is understood that the dredging suggested by the Forster Keys Progress and Ratepayers Association in the Boomers Channel is to improve navigation to the Western Step and that suggested dredging by the Oyster Farmers Association (as indicated on the maps in **Appendix A**) was to improve access to the oyster leases on the north-eastern side of Wallis Island.

As noted in **Section 1.6**, strong concern was expressed regarding any dredging of the sand plug at Hell's Gate (on the north-western corner of Godwin Island) by the Oyster Farmers Association, Fisheries also echoed these concerns. It is believed this would lead to increased tidal velocities, potentially damaging upstream and downstream oyster leases and affecting the prawn fishery in the channel.

As the sand shoal at the top of the channel leading to The Step is part of the Hell's Gate sand plug, a dredged channel to the north-west of this was investigated to improve navigation depths through the Boomers Channel in this location. This channel could also be used to gain access to the oyster leases from the west.



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As an alternative to dredging the corner at Hell's Gate to improve navigation depths leading to The Step, the removal of the oyster leases was suggested by NSW Maritime, Fisheries and the Oyster Farmers Association, as they lie over the deepest section of the channel and are not used to full potential, partly due to high currents (see **Section 1.6**). It is understood that oyster racks have since been removed.

Accordingly three navigation channel dredging areas are proposed as shown on **Figure 4.1**: Western Step; section of Wang Wauk (Boomers) Channel to the west of Hell's Gate; and the western channel at The Step together with a sediment trap within The Step to slow encroachment of the dropover into the *Posidonia* bed.



Figure 4.1 Preliminary Locations for Navigation Channel Dredging

4.2 Disposal/ Re-Use of Dredged Sediment

4.2.1 Potential Disposal Sites within the Estuary (islands, water-based)

It must be noted upfront that there are a lack of suitable and sustainable sites for sediment disposal in / around Wallis Lake.

Tern Island

As noted in **Section 3.5**, Tern Island has historically been used as a disposal site for dredged sediment and is identified in the LPMA's Crown Harbour Project as a stockpile site over the next 15



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years. Tern Island was identified by Boatland Marine and the Oyster Farmers Association as a deposition/ stockpile site and was previously considered by Council for use as a renewable sand depot.

Although the 2005 proposal for the renewable sand depot did not go ahead, it is recommended that this option be re-examined and operational details refined in an attempt to address previous resident concerns in relation to traffic and noise. Refer **Figure 4.2** for location of potential disposal site.

Recent communication with Council (G. Tuckerman, May 2013) indicated that after dredging which took place in 2012 Tern Island is now full. A higher end landform would need to be created for further sediment deposition to occur here.



Figure 4.2 Locations for potential disposal sites within the lower Wallis Lake estuary

North eastern tip of Miles Island

This area was suggested by Council and is popular for swimming and wading. Deposition of dredged sand in this area could enhance recreational amenity. However, movement of dredged sediment into Breckenridge Channel could be an issue. Current shallowing of sections of Breckenridge Channel was identified by some Stakeholders, see **Section 1.6**. Refer **Figure 4.2** for location of potential disposal site. Recent communication with Council (G. Tuckerman, May 2013) indicated that 5,500 m³ of sediment was deposited here in 2011 and only small volumes of sand may be accommodated in the future.



South side of Mather Island Spit

The south side of Mather Island Spit is heavily impacted by flows in the Wallamba River and erosion is occurring on the northern side of the spit. Boatland Marine thought that the spit at the eastern end of Mather Island was close to breaking through and The Oyster Farmers Association identified this as an alternative disposal site. As noted in **Section 1.6** the eastern tip of Mather Island was formed by dredged spoil to protect water quality within The Paddock from flows discharging from the Wallamba River. Refer **Figure 4.2** for location of potential disposal site. However, given the restricted space, potential environmental impacts and expected eventual return of sand to the estuary if placed in this location, it is considered unlikely that this location would provide a suitable and sustainable long term solution.

4.2.2 Potential Beach Disposal/ Beach Nourishment

Tuncurry Beach and Dune

Tuncurry Beach was identified by Council as a future (say in 15 years' time) disposal site for marine sands dredged from Wallis Lake. Sand could either be pumped onto the active beach profile or into the dune system. Dunecare suggested that sand be pumped into the swale landward of the foredune to reduce its width. As noted in **Section 1.6** vegetation cover has not established as well or as quickly in this area, as it does not receive cooling breezes in summer. In addition, the foredune is very narrow just to the north of the beach access way from the Rockpool carpark. Accordingly there is potential for a breakthrough in this location during a major ocean storm which could then flood the swale. A fence has been installed to try to collect sand to build up the dune in this location. Hence filling a section of the swale behind this area to increase the width of the foredune would be beneficial. This was also supported by LPMA. Refer **Figure 4.3** for location of potential disposal site.

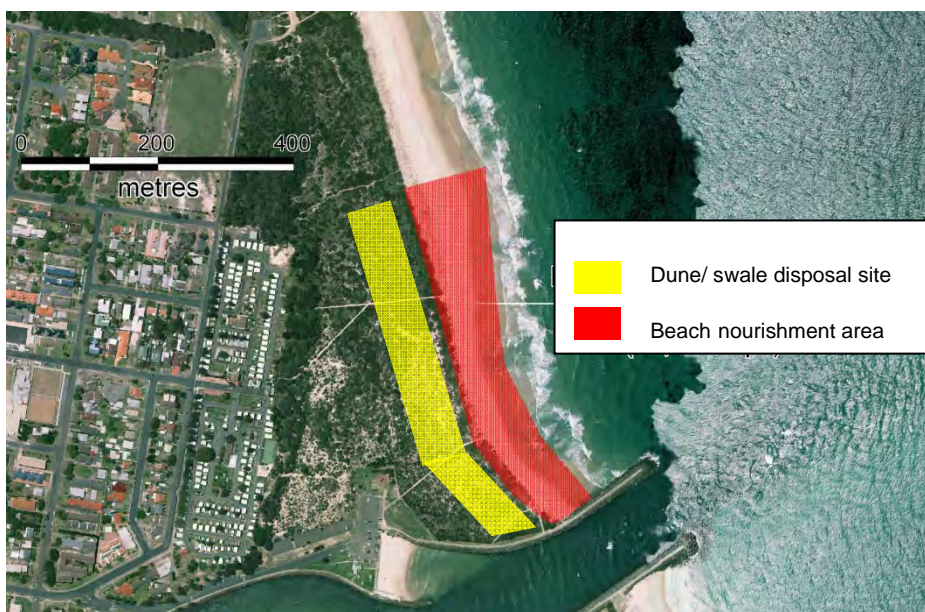


Figure 4.3 Potential dune/ swale disposal site and beach nourishment area at southern end of Nine Mile Beach



Beach Nourishment

A Coastal Processes and Hazard Definition Study is currently being prepared for Council. Previous work by WorleyParsons for Landcom identified that Tuncurry Beach is not subject to long term recession due to sediment loss but, as for other beaches, shoreline recession is likely to occur as a result of sea level rise.

The Coastal Processes and Hazard Definition Study may identify areas along the Great Lakes coast that would benefit from periodical beach nourishment to assist in protecting assets at risk from coastal processes (Bennetts Head at the northern end of One Mile Beach was suggested by a local surfer). Refer **Figure 4.3** for location of potential nourishment.

4.2.3 Sand for the Building and Construction Industry

Moses and Ling (2010) reported on the recent dredging of Swansea Channel and the Myall River near the entrance to Port Stephens (Corrie Channel). Marine sand from Swansea Channel was used for beach re-nourishment and land fill. Marine sand from the Myall River was used for land filling two private sites with development consent, land filling a Council reserve and re-nourishment of Jimmy's Beach, Hawks Nest. Payments for a total of 22,500 m³ of fill sand for the development sites were reinvested into the dredging project.

Use of dredged sediment for development of low-lying land (land within the 1% AEP flood extent) in the Forster–Tuncurry area was suggested by some stakeholders. Sites identified included Lani's land at Forster, Fazio Park at Tuncurry, Pipers Creek behind the school playing fields, southern parkway, private land on Tea Tree Road on the southern side of Folly Foot Farm. Other potential sites were identified in the Chapmans Road area, Tuncurry.

Landcom also propose developing land at North Tuncurry which may require fill and LPMA requested consideration of a higher use for dredged sand as per other recent maintenance dredging projects referred to above.

WMA (2005) considered the use of dredged sand for the building and construction industry such as for bulk fill and backfill; fine aggregate in concrete manufacture and other purposes such as in mortar, plaster or asphalt; or in horticulture for top dressing. The factors affecting the suitability of sand for specific purposes were also identified, i.e.: relative abundance and comparative low cost as a bulk product; and uniformity of composition, workability, material soundness, permeability and chemical inertness.

In the case of concrete sands, impurities such as clay, shell, or organic material are unacceptable as they affect concrete strength and sands generally need to be well graded (i.e. a mix of fine, medium and coarse sands). Analysis of dredged spoil stockpiles indicated a variable shell (and silt) content and very well sorted/ poorly graded sands, i.e. generally unsuitable for structural concrete. However, with some treatment (screening and cycloning) to reduce the shell (and silt) content and blending with coarser and finer sands it would be possible to use these sands in concrete manufacture (if a better source was not available).

Without treatment the sands were found to be suitable for use as fill, both as bulk fill and as backfill around pipes and cables. The sands were also considered suitable for bedding under concrete slabs,



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but because of their uniform size and round shape, would be somewhat more difficult to compact, and so would not be preferred for this purpose.

WMA (2005) reported that the local concrete sand market was almost entirely supplied by a mix of dune sand from the CSR Readymix quarry at Darawank, and crusher dust from Pacific Blue Metal at Nabitac/ Failford. In total this market averages around 24,000 tonnes or 15,000 m³ per annum, with reserves reportedly exceeding 50 years supply. The local market for backfill and bedding sand was estimated at 20,000 m³ per annum, with the demand for bulk fill estimated at up to 20,000 m³ for future specific individual lot filling or road works. A total ongoing, average annual fill sand demand of at least 40,000 m³ was therefore considered likely.

WMA (2005) found that, based on the available evidence, good quality fill sand sold for around \$20 to over \$23/ m³, with the price for poorer quality sand being around \$13/ m³. An estimated realistic price for material stockpiled on Tern Island was thought to be between \$15 and \$18/ m³.

PWD (1988) also discussed the beneficial use of dredged sand within the building industry. The predicted demand for concrete sand at the time was considered too low to support the operation of a processing plant and dredging personnel. Problems with supplying fill sand from dredging works included the lack of a continuous supply source, as dredging is carried out periodically, and at the time the BMG/ Birdon Group considered that commercial sand extraction from dredged spoil at Wallis Lake was not viable.



5 ASSESSMENT OF OPTIONS

5.1 Scope of Assessment

The Brief for this Study related to the establishment of a pipeline to deliver dredged marine sands to Tuncurry Beach; a Coastal Processes/ Hydrodynamic Study (see **Appendix C**) as an ongoing tool for Council to assist in the management of Wallis Lake; and maintenance dredging of a navigation channel at The Step and associated Review of Environmental Factors relating to the dredging operations (see **Appendix D**). The disposal site would be subject to a separate environmental assessment and approvals process.

Although various disposal sites (other than Tuncurry Beach) have been identified a detailed assessment of these sites is beyond the scope of this Study. However, a general assessment of potential island/ water-based disposal sites is provided in **Section 6.2.1**, as well as an assessment of disposal of dredged sediment on the Tuncurry Beach active beach profile.

5.2 Navigation Channel Requirements

Historical navigation channel dredging by PWD upstream of the bridge was to a depth of 1.6 to 1.8 m below Chart Datum (approximately -2.6 to -2.8 m AHD) with an additional allowance of 0.2 to 0.4 m to allow for infilling (PWD 1988). Channel dredging downstream of the bridge was to 2 m below Chart Datum (approximately -3 m AHD) with an additional allowance of 0.5 m for infilling (PWD 1988).

As noted in **Section 1.6** NSW Maritime indicated navigation channels should be at least 2 m deep and 30 m wide, consistent with the recent dredging of Tuncurry and Pipers Channels. The design depth for the Tuncurry Channel was -2 m AHD and for the purposes of this Study -2.5 m AHD has been adopted as the design dredge depth.

5.3 Dredging Options

The Step Navigation Channel Dredging and Sediment Trap

Dredging the western channel at 'The Step' is considered feasible to improve navigation. Local sediment transport regime is moderately active; however, the alignment of the dredged channel in the direction of the flow will act to reduce siltation. Estimates of channel infilling indicate that maintenance dredging would be required at around five year intervals. Minimal impacts are expected on the tidal regime from dredging at 'The Step'.

Dredging a sediment trap at The Step is not considered to be effective due to changes to the local flow and sediment transport patterns. Direct removal of sediments from the lakeward slope of the dropover is likely to provide a better option to avoid progradation onto *Posidonia* beds. To maintain the dropover in its current location would require removal of around 6,000 m³ of sand per year. This could be removed at 5 to 10 year intervals. In addition, dredging the navigation channel at The Step may assist in reducing progradation along much of The Step, however, local increases in sediment deposition are likely at the end of the dredged channel.



Western Step

Dredging a navigational channel at The Western Step is considered feasible to improve navigation to and from the main body of Wallis Lake via the northern and western sides of Wallis Island. The local sediment transport regime is relatively inactive and estimated infilling rates are low. Some impacts are expected on tidal flows with a significant increase in the tidal prism upstream as a result of the channel deepening. A more detailed assessment would be required to quantify the impacts of this option.

Section of Wang Wauk (Boomers) Channel

Dredging a navigation channel at Wang Wauk (Boomers) Channel appears to be ineffective as this area is characterised by a relatively active sediment transport regime with channel infilling estimated to occur rapidly following dredging.

5.4 Typical Dredge Plant and Delivery Methods

5.4.1 Dredge Plant

The type of dredge plant likely for use within Wallis Lake would be a cutter suction dredge (CSD). Cutter suction dredgers are described in terms of their intake and outlet pipe sizes, e.g. 10/8 dredge (i.e. 10" intake and 8" outlet). The outlet size establishes the delivery pipeline size.

A cutter suction dredger is generally not self propelled like a trailer suction hopper dredger. It is generally a floating barge type vessel. A small cutter suction dredger undertaking work recently in Tuncurry Channel is shown in **Photo 5.1**. This is an 8/6 cutter suction dredge with a minimum dredging depth of 1.2 m and maximum depth of 8.0 m. The pipeline length for this dredge is up to 3.5 km, although the maximum pumping distance for the dredge without booster pumps is 1.2 km for sand and silt.



Figure 5.1 Cutter Suction Dredge (National Dredging Services) at Tuncurry Channel



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During dredging operations the cutter, which is located at the end of a ladder, is lowered to the bed. The cutter revolves through the bed material and in so doing loosens it. Agitated material is sucked up by the on-board pumps into the pipe intake located behind the cutter and via the on-board pipework in the form of a hydraulic slurry. Typically the solids concentration of the hydraulic slurry is in the order of 20% to 35% by weight.

5.4.2 Delivery of Dredged Sediment

Dredged material could be transported to disposal/ stockpile sites via a number of methods:

- pumping the material in the form of a hydraulic slurry via a discharge pipeline (which may be a combination of floating, submerged and onshore sections) to a land-based or water-based disposal site
- transfer to a hopper barge for transport to a land-based site where dredged material would be removed from the barge by excavators
- pumping to a temporary water-based site and then re-dredged and pumped/ transported to a final disposal/ stockpile site.
- transport and placement using a bottom dumping barge, in a water-based disposal site.

Obviously pumping to a permanent stockpile/ disposal site would be the most efficient means as it avoids double handling of the dredged material. For disposal via a discharge pipeline, the distance over which the vessel can pump the material is governed by the size of the pump installed in the dredger and the type of dredged material. This can be supplemented by placing booster pumps in series at predetermined locations along the discharge line, to increase the pumping distance. For small to medium sized dredgers the use of lightweight sections of high density polyethylene (*HDPE*) pipes incorporating quick release couplings are recommended for onshore sections of pipeline as they can be readily man handled, assembled and disassembled.

Placement of the material from the discharge pipe on to the nominated onshore placement area is typically managed by controlling the direction of flow of the discharge water with a valve system incorporated along the pipeline. Material is subsequently worked by conventional land based plant and equipment such as bulldozers and front end loaders. Management of the water in the slurry is required to ensure satisfactory quality of the return water to the receiving waterway.

5.4.3 Pipeline Intake and Outlet Locations

Both NSW Maritime and DPI Fisheries suggested an intake at the eastern end of Tern Island. Nominating an intake at Tern Island provides flexibility to continue using Tern Island as a short to medium term stockpile site (as per the Forster–Tuncurry Crown Harbour Project, see **Section 1.4.2**) or the intake site for disposal of dredged spoil at Tuncurry Beach. This may also address timing issues in relation to demand for fill sand and the need for navigation dredging, i.e. if fill for development was not required, sand could be pumped to Tuncurry Beach and if fill was required it could be stockpiled and then transported from Tern Island.



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Dredged material need not necessarily be trucked to development sites, for example, Tern Island could be an intake point for pumping up the Wallamba River to development sites on Chapmans Road, in a similar fashion to that proposed in the 2006 Oyster Lease Dredging (mouth of Wallamba River) EA, see **Section 1.5.2**.

For pumping to Tuncurry Beach, the outlet could be located in the swale behind the frontal dune (extension pieces could be added if dredged marine sand was to be placed on the beach or nearshore area).

Based on a dredge pumping distance/ booster pump pumping distance of 1 km, two to three booster pumps would be needed to transport sand to Tuncurry Beach from Tern Island.

A network of booster pumps would be needed on Wallis and Cockatoo Islands if material dredged from Boomers Channel, the Western Step and The Step was to be transported via pipeline to Tuncurry Beach via Tern Island.

5.4.4 Pipeline Route

As the disposal site for material to be dredged from The Step and other proposed navigation channel dredging has not been determined, discussion on a dredged sediment pipeline route has been confined to the feasibility of installing a permanent pipeline between Tern Island and Tuncurry Beach for future disposal of marine sands at Tuncurry Beach.

As per the description of the foreshore in **Section 1.3.2** there are a number of constraints to installing a permanent pipeline along the shoreline. These include the fishing fleet jetties and moorings along Point Road, Boatland Marine facilities, the DPI Fisheries boat ramp, fishing fleet jetties/ moorings (and services to these) seaward of the Forster–Tuncurry Bridge, the Fishing Co-op slipway and service mains as shown in **Appendix A**. Potential future improvements or relocation of the fishing fleet are also a consideration (e.g. if the Tuncurry Marina was to go ahead). Areas used for anchoring and channels which require dredging from time to time also need to be taken into account for submerged pipeline routes.

Depths and dimensions of services have not currently been reviewed, and further consideration of this would be required if a buried pipeline was proposed. The requirements of a buried pipeline (i.e. conflicts with existing services and the cost of trenching) versus a surface pipeline (i.e. visual impact and associated vegetation/ landscaping costs) would need further assessment to determine the optimum design, and a combination of buried and surface sections is a likely result. The proposed pipeline route is also likely to comprise some fixed and some removable sections as described in **Table 5. 2**. See **Figures 5.2** for the suggested pipeline route between the entrance and Boatland Marine and **Figure 5.3** for an extension to opposite Tern Island.



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Table 5.1 Description of Potential Pipeline Route and Constraints

Chainage (m)	Description	Constraints
0-530	<p>The seaward extent of the pipeline is at the crest of the Tuncurry Beach dune. A temporary length of pipe would be attached to CH0 to extend the pipe down onto the beach and along the beach as necessary.</p> <p>From CH0 to CH480 the pipeline route runs through sand dunes and reserves. The pipe could be buried or fixed on the surface. If the pipe were fixed on the surface then there is scope to reduce visual impact through the use of vegetation and landscaping.</p> <p>Between CH480 and 530 the pipe would need to be buried under Rockpool Road or a temporary length of pipe placed across the road when required. If a temporary length was used then a ramp over the pipe would be required, during its use, to retain access along the road.</p>	<p>buried services between CH460 and 500</p>
530-740	<p>The pipeline runs adjacent to the foreshore walkway. The pipe could be buried or fixed on the surface. If the pipe were fixed on the surface then there is scope to reduce visual impact through the use of vegetation and landscaping.</p>	<p>Fishing boat jetties. Although not shown on Figure 5.2 it is likely that power supplies run from the main lines out to each jetty.</p> <p>Storm water pipes and outlets into the lake.</p> <p>John Wright Park has recently been upgraded by Council.</p>
740-870	<p>The pipeline runs adjacent to the foreshore walkway. The pipe could be buried or fixed on the surface. If the pipe were fixed on the surface then there is scope to minimise visual impact through the use of vegetation and landscaping.</p> <p>Due to the constraints along this length consideration could also be given to a temporary section either along the foreshore (land), floating or submerged</p>	<p>Fishing Co-op, boat ramp, fishing fleet services and storm water pipes/outlets.</p> <p>Further consideration would be required on the merits of a land versus a water based route, and a permanent versus temporary option.</p>



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870-1080	The pipeline runs adjacent to the foreshore walkway. The pipe could be buried or fixed on the surface. If the pipe were fixed on the surface then there is scope to reduce visual impact through the use of vegetation and landscaping.	Fishing fleet services and storm water pipes/ outlets.
1080-1270	The pipeline runs along the foreshore reserve. The pipe could be buried or fixed on the surface. If the pipe were fixed on the surface then there is scope to minimise visual impact through the use of vegetation and landscaping.	Storm water pipes/ outlets.
1270-1330	The pipeline runs along the foreshore reserve. The pipe could be buried or fixed on the surface. If the pipe were fixed on the surface then there is scope to minimise visual impact through the use of vegetation and landscaping.	Various buried services, including storm water outlets into the lake. Note that the services shown on the bridge are likely to be fixed onto the bridge, therefore as the pipeline route would go under the bridge conflict with a number of the services shown could be avoided.
Extension 1270-1925	Buried pipeline within the Point Road road reserve (to allow vehicle access to jetties/ moorings and the public boatramp) and Palm Road road reserve to the foreshore (if the proposed redevelopment of Fazio Park as outlined in the Crown Harbour Project proceeds this work could be undertaken concurrently).	Storm water pipes/ outlets.
1925-2210	Pipeline over the tidal flats from the intersection of Point Road and Bay Street to the western end of Tern Island (this is downstream of the fishing fleet jetties/ moorings and traverses a shallow area historically, but not currently, used for oyster farming). Alternatively, if the proposed bridge to Tern Island was constructed the pipe could be fixed to the bridge structure. In the absence of a bridge a temporary floating/ surface pipeline could be used.	
1925-2210 (alternative)	Another option is continuation of the pipeline to an intake on the Point Road foreshore.	Services, stormwater pipes/ outlets



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Figure 5.1 Potential Pipeline Route – Entrance to Boatland Marine



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Figure 5.2 Potential Pipeline Route – Boatland Marine to opposite Tern Island



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Alternatively, as the frequency of dredging navigation channels is expected to be only every 5-10 years on average, a temporary pipeline and booster pump(s) could be used, depending on the proposed deposition site at the time. Pipeline length (distance over which pumping is required), elevation differences along the route, and pumping rates would determine the number and capacity of booster pumps required.

Note that dredge contractors prefer floating pipelines for maintenance purposes and that a pipeline would usually only be submerged in the case where it would pose significant navigation impacts. As for floating pipelines, surface pipelines on land are more readily accessible for maintenance purposes than buried pipelines but would need to be appropriately sited and protected to prevent unintentional/intentional damage.

5.5 Processing/ Treatment

It is assumed that any material placed in the Tuncurry dunes or beach area would be marine sands. Sand with higher silt content may be suitable for filling the swale. Accordingly no processing or treatment is proposed for disposal of dredged material on Tuncurry Beach.

5.6 Indicative Volumes and Dredging Frequency

Likely dredge volumes for the recommended dredging sites investigated are shown in **Table 5.1**

Table 5.2 Dredging Locations, Volumes and Infill Periods

Location	Estimated Volume	Estimated Time to Infill
Western Step	30,000 m ³	around 5 years
The Step western channel	15,000 m ³	up to 20 years
The Step dropover	30,000 m ³ based on the annual average volume of sand extending the dropover into the main body of Wallis Lake (6,000 m ³ / year) and dredging every five years	5 years

Dredging a section of Wang Wauk (Boomers) Channel in the vicinity of the north-eastern corner of Wallis Island was also investigated but was not considered feasible as infill rates were short, estimated at one year (see **Appendix C** for further information). Also, the sediment trap as indicated in **Figure 4.1** was not considered feasible.

5.7 Estimated Capacity of Lake/ Beach Disposal Sites

The estimated capacity of the potential lake/ beach disposal sites is as follows:



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- Tern Island - 48,000 m³ was estimated by PWD 1988, however, following the disposal of around 40,000 m³ in 2012/2013 (G. Tuckerman, GLC, personal communication, 2013) this site is now almost full.
- North eastern tip of Miles Island – Estimates in early 2011 were approximately 10,000 m³ (to 0.0 m AHD), however, following the deposition of 5,500 m³ in later 2011 (personal communication, G. Tuckerman, GLC, 2013) only limited additional space is now available (5,000 m³ maximum).
- South side of Mather Island spit, approximately 5,000 m³ (to 0.0 m AHD). However, this site should be subjected to full examination as it is erosion prone (refer to **Section 8.2 of Appendix C, Coastal Processes Report**).
- Tuncurry Beach dune/ swale 30,000 m³ (estimated by PWD 1988).
- Tuncurry Beach (say up to 30,000 m³ per dredging campaign).

In addition WMA (2005) estimated the ongoing, average demand for fill sand to be around 40,000 m³.

5.8 Pipeline Options - Capital and Maintenance Costs

Table 5.3 indicates a cost estimate for pipe supply, trench excavation and backfilling. As previously discussed it is likely that sections of the pipeline would be laid on the surface. A cost for this has not been included as it has assumed that the cost of trenching and backfilling would be comparable to costs associated with landscaping around a surface pipeline, to reduce visual impacts and prevent potential damage to the pipeline.

Note that these costs relate to the feasibility of a pipeline and do not take into account concept and detailed design, technical specifications, environmental assessment and approvals, service relocation or geotechnical investigations etc. A 20% contingency has been included. Reference was made to Rawlinsons 2009 for excavation and backfilling costs.

Table 5.3 Indicative Cost for Pipe Supply, Trenching and Backfilling

Location	Approx. Pipe Diameter (mm)	Estimated Cost (+/- 50%)
Pipeline from Tuncurry Beach to Boatland Marine (1330 m)	200	\$330,000
	300	\$530,000
Pipeline from Tuncurry Beach to the end of Point Road (2210 m)	200	\$550,000
	300	\$890,000



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The supplier advised that the lifespan of a polyethylene pipe should be a minimum of 50 years when trenched. The lifespan may be reduced when the pipe is laid on the surface as it is more prone to damage (e.g. vandalism, damage from being driven over, expansion and contraction (and possible breakage) in response to air temperature etc.).

5.9 Financial Feasibility

Council has provided costing information from previous dredging activities within Wallis Lake. These are summarised in **Table 5.4** below.



Table 5.4 Costs for previous dredging works on Wallis Lake (source: Great Lakes Council)

Project	Extracted volume (m ³)	Approx. Expenditure	Approx. cost /m ³
Tuncurry Channel	17,340	\$275,000	\$16
Pipers Creek Channel	4,504	\$151,000	\$34
Corrie Channel	27,000	\$470,000*	\$17

*excludes site management costs and landing costs @ \$2.50/m and some other site management costs eg fencing, land form stabilization

As discussed in **Section 5.6**, it is estimated that there would be in the order of 60,000 to 70,000m³ of material to be dredged every 5 years. Based on an estimated cost to dredge of say \$17/m³ (refer **Table 5.4**), the total cost would be approximately \$1 million every 5 years. The cost of the fixed pipeline would be additional to these dredging costs. A fixed pipeline would therefore add a further say 40% to 90% to this cost (depending on pipe size and pipeline route chosen). This significant increase in additional capital expenditure would be difficult to justify.

If the pipeline were to also be utilised for dredging activities undertaken by the Oyster farmers in the area this could approximately double the estimated dredge volume which would improve the financial feasibility of the pipeline option.

As noted above, the frequency of this dredging would be approximately every five years at the most, so a fixed pipeline would lie unused for a vast proportion of the time and would be utilised say a maximum of 10 times within its lifespan of 50 years. Due to the long periods that the pipeline would remain idle there may be maintenance and vandalism issues that would also need to be factored into the operational cost of this option.



6 ENVIRONMENTAL CONSIDERATIONS

6.1 Potential Issues

6.1.1 Short Term Impacts

Potential short term impacts associated with dredging, delivery by pipeline and disposal of dredged material in the lower estuary and Tuncurry Beach include turbidity, exposure of acid sulphate soils, direct and indirect impacts on aquatic habitat and impacts on other waterway uses including navigation. Consideration of these issues in relation to dredging The Step is detailed in the REF for this proposal, see **Appendix D**.

With regard to disposal at Tuncurry Beach, many concerns relating to beach disposal can be addressed through the appropriate timing of activities (e.g. in winter after the mullet run when recreational use is low, visitation to the adjacent caravan park is low and migratory bird species are absent) and management arrangements (e.g. progressively undertaking work along the beach so that some sections of the beach are always open to the public and unaffected by plant and equipment). Similarly, issues associated with the pipeline such as noise from booster pumps can be addressed through acoustic housing and other management measures such as hours of operation.

6.2 Potential Longer Term Impacts (Beach and Estuary)

Changes to the hydrodynamic regime (e.g. tidal flow behaviour) and changes to sedimentary processes (e.g. patterns of erosion and accretion including infilling of dredged channels) in relation to dredging were discussed in **Section 5.3**. Impacts of disposal of dredged sand on the active beach profile at Tuncurry Beach are discussed in **Section 6.2.2**. Comment is also provided on the potential implications of disposal of dredged material on the lake bed on the southern side of Mather Island spit. Refer to **Appendix C** for further information.

6.2.1 Lower Estuary and Tuncurry Beach Disposal Sites

Tuncurry Dunes/ Swale

As noted in **Section 4.2.2** dredged material could be used to widen the frontal dune and reduce the width of the swale. This would result in the burying of existing vegetation, possible burying of small fauna and temporary displacement of larger animals. Dune planting, adjustment of pedestrian access ways to the beach and the existing irrigation system would be required. There would be short-term impacts associated with noise from plant and machinery used to spread and shape sand and to create beach access, however, as the dune area is fenced this would be restricted to the formal access points. The outcomes of this work would be beneficial in reducing the likelihood of a breakthrough to the swale during a large storm event and in providing a more suitable micro-habitat for the establishment and maintenance of dune vegetation. Refer **Figure 4.3** for potential disposal location.



Tuncurry Beach (active beach profile)

Short-term impacts associated with disposal of dredged marine sands on Tuncurry Beach would include restriction of public access in the immediate vicinity of works, potential temporary discolouration of water if fines were present in the dredged sand and noise from plant and machinery. Works would need to be undertaken before April and after June to avoid the time when beach hauling is undertaken for the mullet run.

Based on the hydrodynamic modeling undertaken (refer **Appendix C**) it is expected that dredge spoil placed in the area identified in **Figure 4.3**, would be relatively stable with minimum sediment loss from the overall estuarine and coastal compartment. The impacts of additional sediment movements associated with beach nourishment on coastal processes, estuarine function and navigation, are expected to be minimal. Beach nourishment, in isolation, is not currently required from a property protection or beach amenity perspective, however, changes to the governing coastal processes and potential development may necessitate on-going nourishment works in the future.

Tern Island

It is recommended that this option be re-examined and operational details refined in an attempt to address previous resident concerns in relation to traffic and noise. As noted in **Section 4.2.1** the LPMA Crown Harbour Project identifies this as a stockpile/ disposal site for the next 10 to 15 years. Environmental impacts associated with this site were identified by WMA (2005). Detailed examination of this option is outside of the scope of this study.

North eastern tip of Miles Island

Deposition of sediment in this area could impact on seagrasses (see **Figure 2.7**), however, creating a larger shoal would provide additional beach area in the lower estuary for recreational use. It could also provide additional roosting habitat for shorebirds, however, disturbance from boats and people would limit its value as additional habitat. Detailed examination of this option is outside of the scope of this study. If this option is to be considered further it is recommended that the potential for sand moving off the shoal into Breckenridge Channel be investigated.

Southern side of Mather Island spit

Deposition of sediment in this area (refer **Figure 4.2**) could provide protection against breakthrough of the narrow spit which prevents flood flows from the Wallamba River from directly impacting on The Paddock. Hydrodynamic and sediment transport conditions have been assessed using the calibrated hydrodynamic model (refer **Appendix C**). Based on model outputs very low current speeds are experienced at this proposed site and it is therefore likely that disposed material would generally be stable.

There could be impacts on seagrasses (see **Figure 2.6**) in this area and the spit is classified as SEPP No.14 wetland, as shown in **Figure 2.7**.

6.3 Planning and Approvals Process

The following discussion relates to estuary dredging and disposal sites and beach disposal as per the scope of this Study.



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Great Lakes Council proposed dredging The Step:

- to enable the waterway to continue functioning as a tidal waterway;
- to reinstate safe navigation; and
- for use as a potential source of fill material for future development.

Under *SEPP (Infrastructure) 2007*, a public authority may undertake a range of activities without development consent including:

“waterway or foreshore management activities”, i.e.:

- instream management or dredging to rehabilitate aquatic habitat or to maintain or restore environmental flows or tidal flows for ecological purposes
- coastal management and beach nourishment.

“port, wharf or boating facilities”, i.e.:

- routine maintenance works (including dredging, or bed profile levelling, of existing navigation channels if it is for safety reasons or in connection with existing facilities).

Refer to **Appendix D**, REF for dredging The Step, for more information on the environmental planning framework in relation to dredging The Step, which would be applicable to other navigation channel dredging.

Installation of a pipeline and placing dredged marine sand in the Tuncurry dune/ swale could be defined as works for the purpose of coastal management and placing marine sand on Tuncurry Beach could be defined as beach nourishment, if necessary for beach amenity and/ or to address coastline erosion and recession. As noted in **Section 4.2.2** and further discussed in **Appendix C** Tuncurry Beach appears stable but, as per other beaches, is at risk from future shoreline recession due to sea level rise. Also as noted in **Section 4.2.2** a Coastal Processes and Hazard Definition Study is currently underway for the entire Great Lakes coast which may identify beaches currently subject to shoreline recession due to net sediment loss.

Placing dredged sand in the waterway could be considered part of the dredging works for maintenance of navigation channels and in the case of the area adjacent to the Mather Island Spit, the placement of dredged material in this location could be defined as instream management to maintain tidal flows for ecological purposes.



7 SUMMARY AND RECOMMENDATIONS

Although this report only addresses dredging for navigation purposes, the hydrodynamic model developed as part of this Study can be used to assess other proposals for dredging in Wallis Lake, such as dredging to maintain oyster leases and access to these leases. It is also a tool that can be used for other future studies on the estuary.

7.1 Recommended Navigation Dredging Locations

A discussion on the recommended sites for navigation dredging is provided below.

7.1.1 The Step - Western Navigation Channel

The REF for this work (see **Appendix D**) found that:

- The proposed dredging of The Step for maintenance of safe navigation would cover an area of 20,900 m² with the total volume of clean marine sand to be removed totaling 15,000 m³.
- Dredging is likely remove some small areas of seagrass consisting mainly of the species *P. australis* occurring on sand mounds at the southern end of The Step.
- Small areas of seagrass adjacent to The Step are also likely to be directly harmed by necessary anchoring and boating movements related to the dredging operations. In addition, depending on the chosen position of pipelines to transport the sand, further areas of seagrass downstream of The Step (i.e. *Z. capricorni*) may be harmed by smothering (if a sunken pipeline option is selected).
- There is the potential for impacts on water quality through increased turbidity – however, due to the nature of the sediment to be dredged (i.e. marine sands), increases in turbidity are likely to be short term and localised as marine sands tend to settle quite rapidly. Mitigation measures (e.g. silt curtains) if required will assure that these impacts are minimal and contained.
- Short term impacts on adjacent seagrass beds occurring within any silt curtains are likely to result from increased turbidity. These include short term light attenuation and smothering as sediments settle to the bottom.
- The proposed dredging will directly impact any benthic infauna and mobile invertebrates which are present at the dredge site.
- There is also the potential for direct and indirect impacts to other marine fauna including a number of threatened and protected species (including pipefish, seahorses and various marine mammals).
- Despite the results of specific testing, there remains some potential for the dredging to affect areas of potential acid sulphate soils and result in impacts on estuarine ecology from acid-sulphate effects.



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- There is the potential for risks associated with the spillage of fuels and oils (i.e. on water quality and aquatic ecology of the Lake).
- There is the potential for some noise related impacts through operation of the dredge equipment and associated barge/ boating activities. However, these are likely to be negligible considering the distance of operations from any residential areas and the current level of noise in the area (from regular boating activities and traffic and residential noises). Noise may impact on marine fauna in the short term.
- Dredging may have some temporary visual related impacts through the presence of barges, pipelines etc.
- There will be short term impacts to recreational and commercial users of the Lake through restricted and altered navigation through the area. Navigation hazards will also be present. However, there will be long term benefits to these users through the outcomes of the proposed dredging.
- Dredging will have no impact on any nearby wetlands (including SEPP 14 wetlands), coastal saltmarsh or mangrove habitats.
- Dredging will have no impact on any heritage items, recorded Aboriginal sites or declared Aboriginal Places.
- No impacts on the built environment would occur.
- The proposed dredging would not significantly affect hydrodynamics or sediment transport processes in this part of Wallis Lake (refer to **Appendix C** for further information)
- Impacts on water quality are not predicted to be significant and can be effectively managed.
- No odour-related problems are envisaged.

7.1.2 The Step - Marine Shoal Dropover

It is recommended that dredging The Step dropover be considered as an option in association with dredging at The Step. The REF for dredging The Step could be expanded in the future to cover this option.

7.1.3 Western Step

As discussed in **Section 5.3** this is considered feasible and further investigations are recommended to assess the potential impacts of this option.

7.2 Disposal Sites

Tern Island and Tuncurry Beach provide ongoing sites for disposal of dredged marine sands. The longevity of Tern Island would depend on the periodical removal of sand from the island (in response to local demand for fill) to maintain capacity for dredging campaigns and local demand for fill sand. The capacity of Tuncurry Beach to receive marine sand is essentially unlimited, however, this would



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essentially see a recycling of sand through the system with some sand moving onto the entrance bar and back into the lower estuary under certain conditions.

The other identified sites would be one-off sites for disposal of dredged material subject to investigation into environmental impacts.

WMA (2005) estimated an ongoing average, future demand for landfill of around 40,000 m³. Accordingly, it is recommended that, if possible, periodical navigation dredging is coordinated with demand for fill for approved development sites, as this would facilitate part funding of dredging works through the sale of sand. As a backup, Tern Island and Tuncurry Beach could be used as stockpile/disposal sites if there was no demand for fill when dredging was required to maintain navigation safety. Alternatively, the Coastal Processes and Hazard Definition Study may identify local beaches that require nourishment to mitigate current shoreline recession.

7.3 Other Recommendations

7.3.1 Provision for Temporary Pipeline

Although the installation and maintenance costs associated with a permanent pipeline appear to be cost prohibitive, provision for a temporary pipeline route could be considered in any proposed improvements to foreshore parks and fishing fleet's facilities, such as that proposed under the Crown Harbours Project.

7.3.2 Navigation Improvements at Hell's Gate

Oyster racks have been removed at Hell's Gate and negotiation to surrender the lease areas and remove any remaining infrastructure (posts etc.) is recommended (if this has not already commenced). Navigation markers would then need to be relocated so that vessels were directed over the deepest section of the channel in this location.



8 REFERENCES

Australian Water and Coastal Studies (AWACS) and JH and ES Laxton Environmental Consultants (1990), *Forster Keys Canal Estate Hydraulics and Ecology – An Overview*.

City Plan Urban Design (2010), *Forster-Tuncurry Crown Harbour Project*. Draft concepts for discussion only August 2010 for the Land & Property Management Authority and Great Lakes Council.

CSIRO (2002), *The response of the southern annular mode, the East Australian Current, and the southern mid-latitude ocean circulation to global warming*. W. Cai, G. Shi, T. Cowan, D. Bi and J. Ribbe.

Department of the Environment, Climate Change and Water (DECCW) (2010a). Estuaries of NSW: Wallis Lake – Physical characteristics.

<http://www.environment.nsw.gov.au/estuaries/stats/WallisLake.htm>

Department of Planning (2001), *Major Project Assessment: Oyster Lease Dredging – Wallis Lake (05_0174)*. Director-General's Environmental Assessment Report Section 75I of the Environmental Planning and Assessment Act 1979. February 2009.

Department of Primary Industries (DPI 2006), *NSW Oyster Industry Sustainable Aquaculture Strategy*.

Great Lakes Council (2010a), *Proposed Maintenance Dredging of Pipers Channel – Wallis Lake Review of Environmental Factors*. Draft Report, January 2010.

Great Lakes Council (2010b), *Proposed Maintenance Dredging of Tuncurry Channel – Wallis Lake Review of Environmental Factors*. Draft Report, January 2010.

Great Lakes Council (2005), *Wallis Lake Estuary Management Study*.

Jelliffe Environmental (1998), *Great Lakes Waterway Recreation Strategy Study*, for Great Lakes Council.

Kirkman, H. (1997), *Seagrasses of Australia*, Australia: State of the Environment Technical Paper Series (Estuaries and the Sea), Department of the Environment, Canberra.

Moses and Ling (2010), "Navigation Dredging – improving outcomes through partnerships and beneficial use of dredged materials", in proceedings 19th NSW Coastal Conference, Batemans Bay, 10-12 November 2010.

National Parks and Wildlife Service (NPWS, 2003), *Little Tern (Sterna albifrons) Recovery Plan*.

Neilson A F and Gordon A D (1996), *Behaviour and Stability of Tidal Inlets – A Case Study of Wallis Lake*, Australian Marine Science Association, Publication No. 86/2, December 1986.

Public Works Department (PWD 1988), *Oyster Farm & Navigation Channel Dredging – Disposal Strategy*.



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resources & energy



Wallis Lake Dredging and Disposal Options Assessment

Rawlinsons Publications (2009), *Rawlinson's Australian Construction Handbook*, 27th edition 2009.

Short A.D. (2006), *Beaches of the New South Wales Coast. A guide to their nature, characteristics, surf and safety*. 2nd Edition 2007.

Webb McKeown & Associates (2005), *Environmental Impact Statement Renewable Sand Depot Tern Island, Tuncurry*.

Webb, McKeown & Associates (1999), *Wallis Lake Estuary Processes Study*.



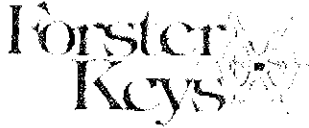
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Wallis Lake Dredging and Disposal Options Assessment

Appendix A - Consultation



Worley Parsons
Infrastructure
Newcastle East

12 AUG 2010

RECEIVED

10 August 2010

1 Victor Avenue
FORSTER KEYS NSW 2428

Phone: 02 6557 6877
Mobile 0408 672242

Email: donald.sheffield@bigpond.com

Dear Dr. Katie Newton,

Thank you for your letter of 5 August 2010 offering to meet with interested stakeholders to discuss the proposal to dredge "The Step" and for the proposed pipeline option for transporting the dredged material to Tuncurry Beach.

Unfortunately, I will away from Forster on the dates you have suggested and will not be returning until 23rd August. I have therefore taken the opportunity to put some thoughts into this letter and will be pleased to discuss them in greater detail after you have had the time to consider them.

Firstly, I fully support the proposal to dredge a channel through "The Step" and my Association has been lobbying Council in an effort to secure this project for a number of years. It has been apparent for a long time that the build up of sand at this entrance to the Lake proper would eventually require the channel markers to be removed in the interests of boating safety. Also an environmental issue was being created with the shoals encroaching on the weed beds and it was likely that the sand shoals were impeding tidal flows to and from the Lake so necessary for a healthy Wallis Lake.

Secondly, whilst I can see merit in the provision of the pipeline to transport the sand away from the dredging site I wonder at the economic value of using it solely to replenish sand lost from Tuncurry Beach. It appears to me that the material is potentially a very valuable commodity for raising the levels of land that will inevitably be required to be raised when the new design flood levels are adopted. However it may be that your report will address this aspect and the design of the proposed pipeline will allow it to be used for both purposes.

I would also like to draw your attention to several other locations where channels require dredging so that if the pipeline proposal is adopted it might be located to serve those other locations when eventually they are dredged.

I have taken the liberty of enclosing a series of location maps and aerial photos to show the areas to which I refer.

- Figure 1 is a site location map
- Figure 2 is an aerial photo of the Pipers Creek and "The Step" area.
- Figure 3 shows the locations of other sites where dredging is required in this location. There are obviously other locations near oyster leases that are not shown. No doubt they are included in your brief.
- Figure 4 shows the section of "The Step" proposed to be dredged in the original proposal.
- Figure 5 shows the section requiring dredging near the NE corner of Wallis Island.
- Figure 6 shows the section of Breckenridge Channel proposed to be cleared in conjunction with the original "Step" proposal.
- Figure 7 is taken from a report by Australian Water and Coastal Studies P/L in 1990 which examined a proposal for a navigational channel from Pipers Creek to the Breckenridge Channel

The material to be cleared from "The Step", the location near the NE corner of Wallis Island and Breckenridge Channel is predominately sand and would be suitable for use on Tuncurry Beach or for land fill. The material from the proposed channel from Pipers Creek to "The Step" however is likely to be 0.5 m of mud over sand and in recent years a significant proportion of this area has become wetlands. Whilst a dredge would be needed to form most of any proposed channel at least a portion could be carried out by land based equipment. The material would also most likely only be suitable for land fill.

I should also advise that I have marked a location in figure 7 of a channel from Pipers Bay into Golden's Bay and this was not shown on the AWCS proposal. It has become very obvious since this report was completed that the options for any connection into the Breckenridge Channel would meet with serious opposition from the Oyster Industry because of the likelihood of any contaminants being flushed into the channel from the very large urban catchment of South Forster that drains into Pipers Creek

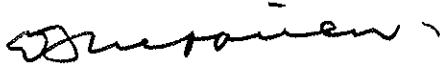
However a channel from Pipers Creek to the north into Wallis Lake is urgently required to improve the tidal flushing of the Creek and the canals in Forster Keys and to improve the quality of the water in this location. This was part of the recommendations in the AWCS report but it focussed on some form of connection to Breckenridge Channel. We believe a more acceptable option would be the connection to Golden's Bay.

In Figure 3 I have also show a short length of the Breckenridge Channel that requires to be dredged at the southern end of the Forster Tuncurry Bridge. This is now forcing boats to travel very close to the sand island used extensively by swimmers during the warmer months and this is potentially dangerous.

I would expect that Council has made various reports available to you that confirm much of what I have mentioned in this letter and I am aware that the Wallis Lake Estuary Management Plan has identified most of these locations that require dredging.

I can also assure that my Association strongly supports any action that will allow work to proceed on clearing the channels that I have identified herein. I hope I have provided you with sufficient information to assist in your investigations and will be pleased to assist in any way I can.

Yours sincerely,

A handwritten signature in black ink, appearing to read "Don Sheffield", with a small flourish at the end.

Don Sheffield
President

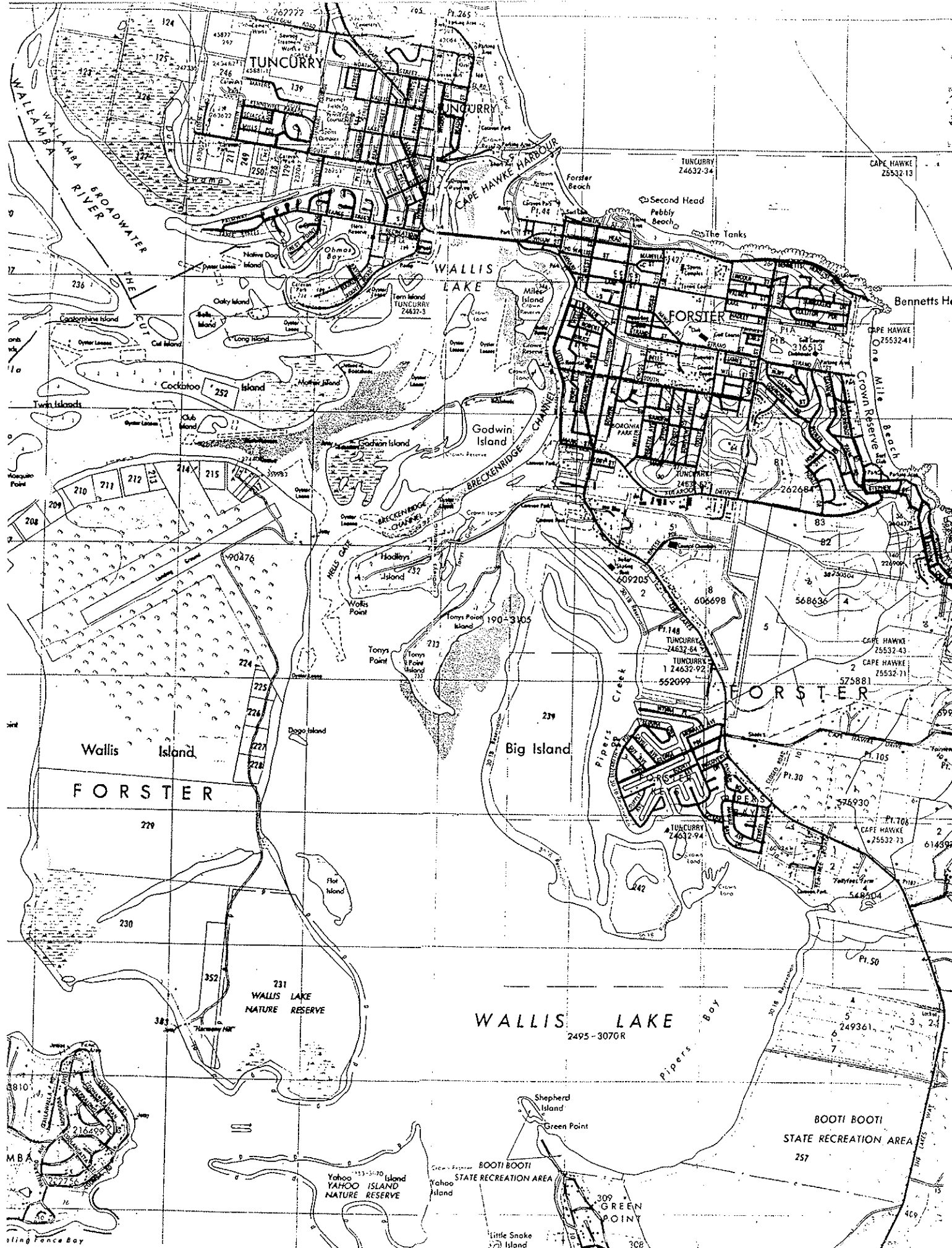
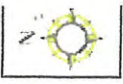


FIGURE 1
SITE MAP

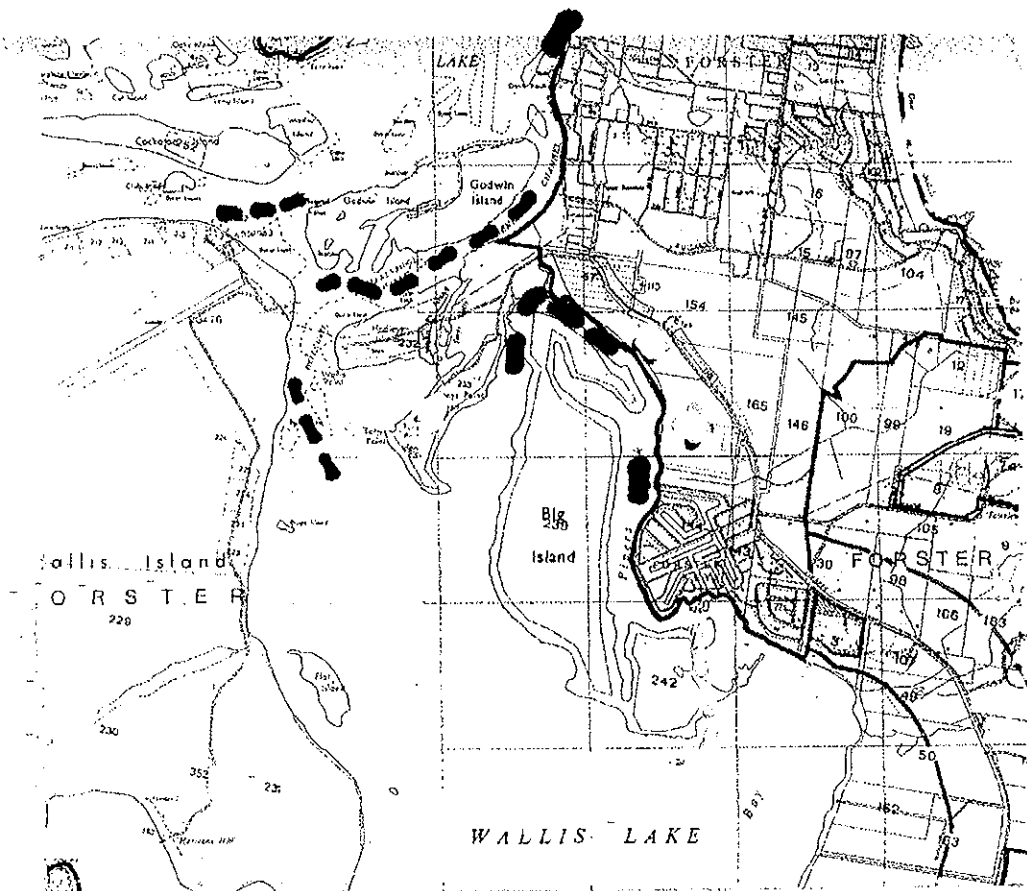
SCHEMATIC - AERIAL IMAGE



26/5/2005

Disclaimer.
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Great Lakes Council accepts no responsibility either in contract or tort (or particularly in negligence) for any errors, omissions or inaccuracies whatsoever contained within or arising from this map.
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FIGURE 2



Proposed Dredge Paths -----

Figure 2 - Proposed Dredging Sites

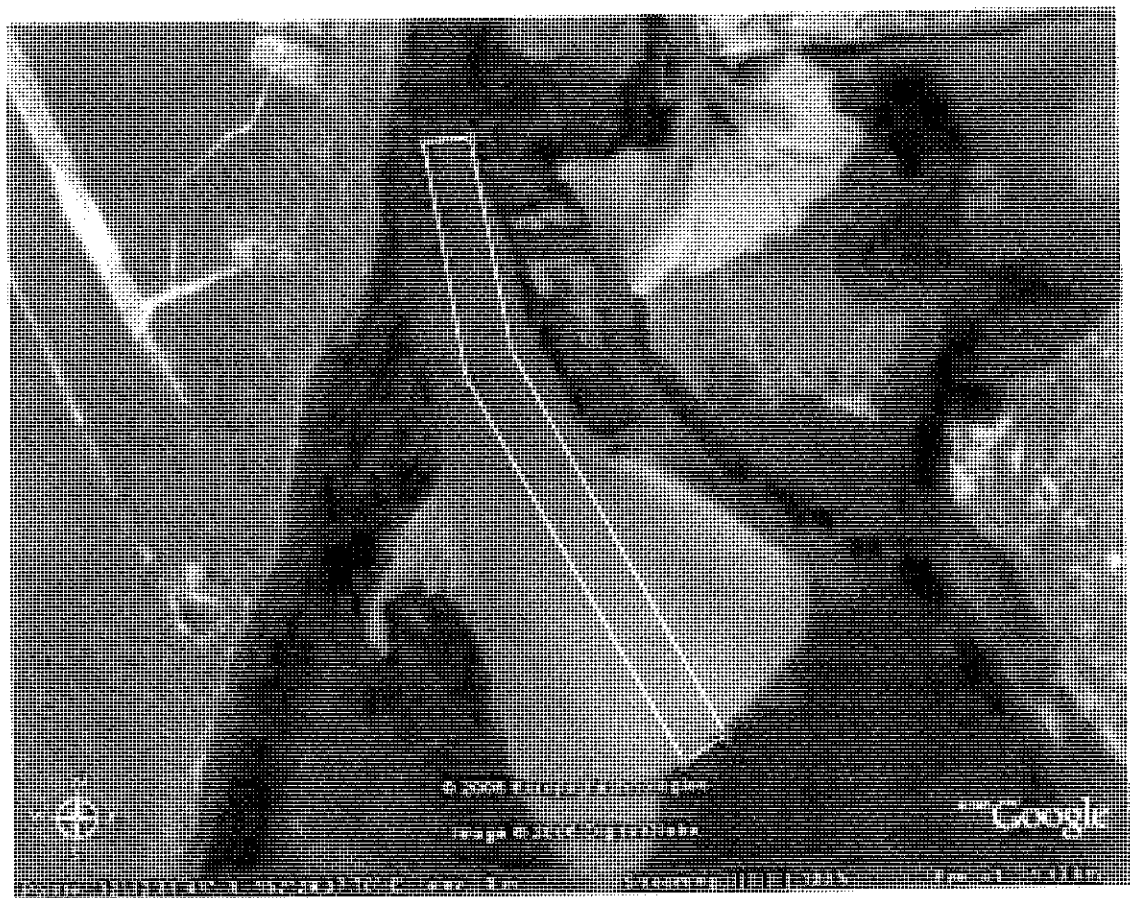


Figure 4- Proposed channel through The Step
GPS Coordinates

1	32° 12' 19.64"	152° 29' 32.49"
2	32° 12' 27.59"	152° 29' 34.91"
3	32° 12' 41.65"	152° 29' 45.31"



Figure 5 – Proposed channel North-eastern point of Wallis Island
GPS Coordinates

1	$32^{\circ} 11' 38.46''$	$152^{\circ} 29' 31.59''$
2	$32^{\circ} 11' 42.28''$	$152^{\circ} 29' 25.32''$

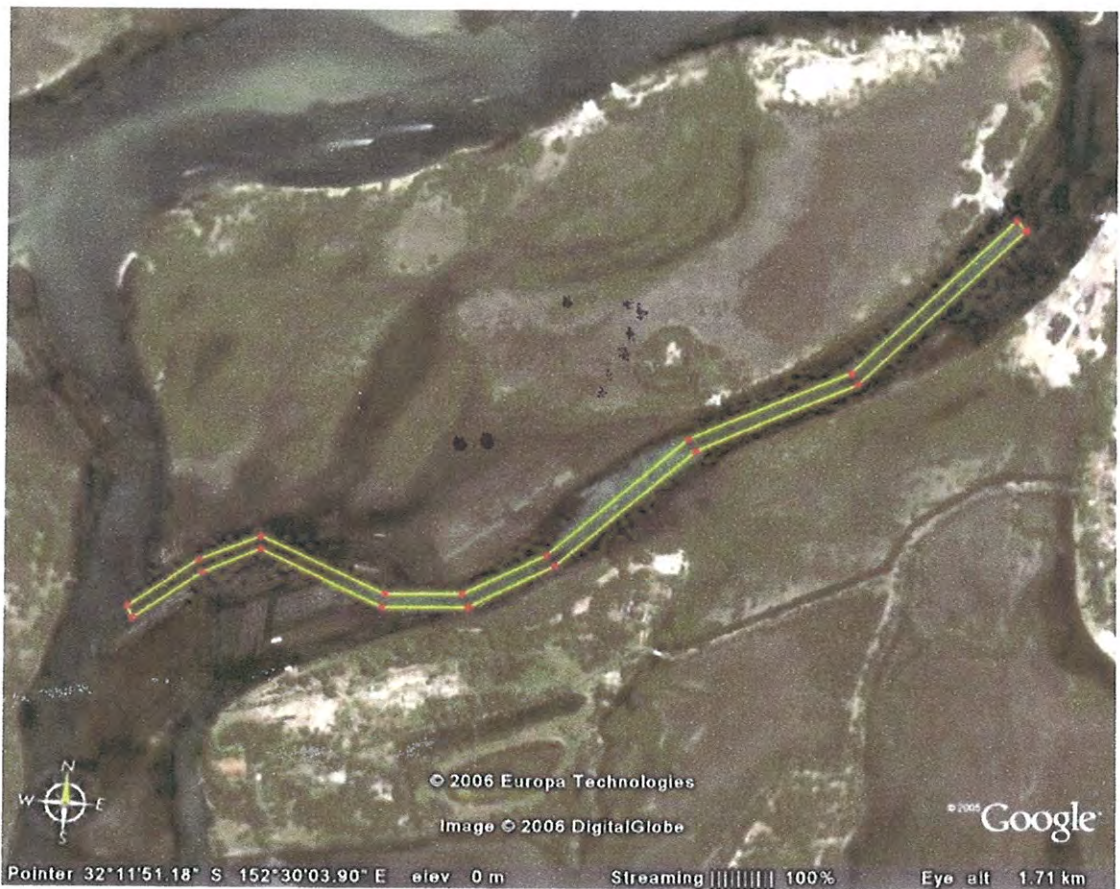
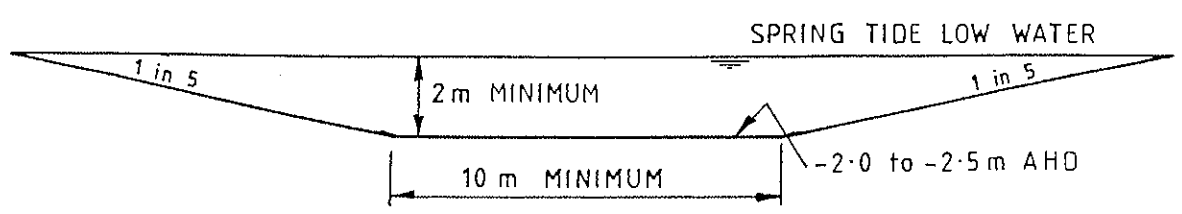
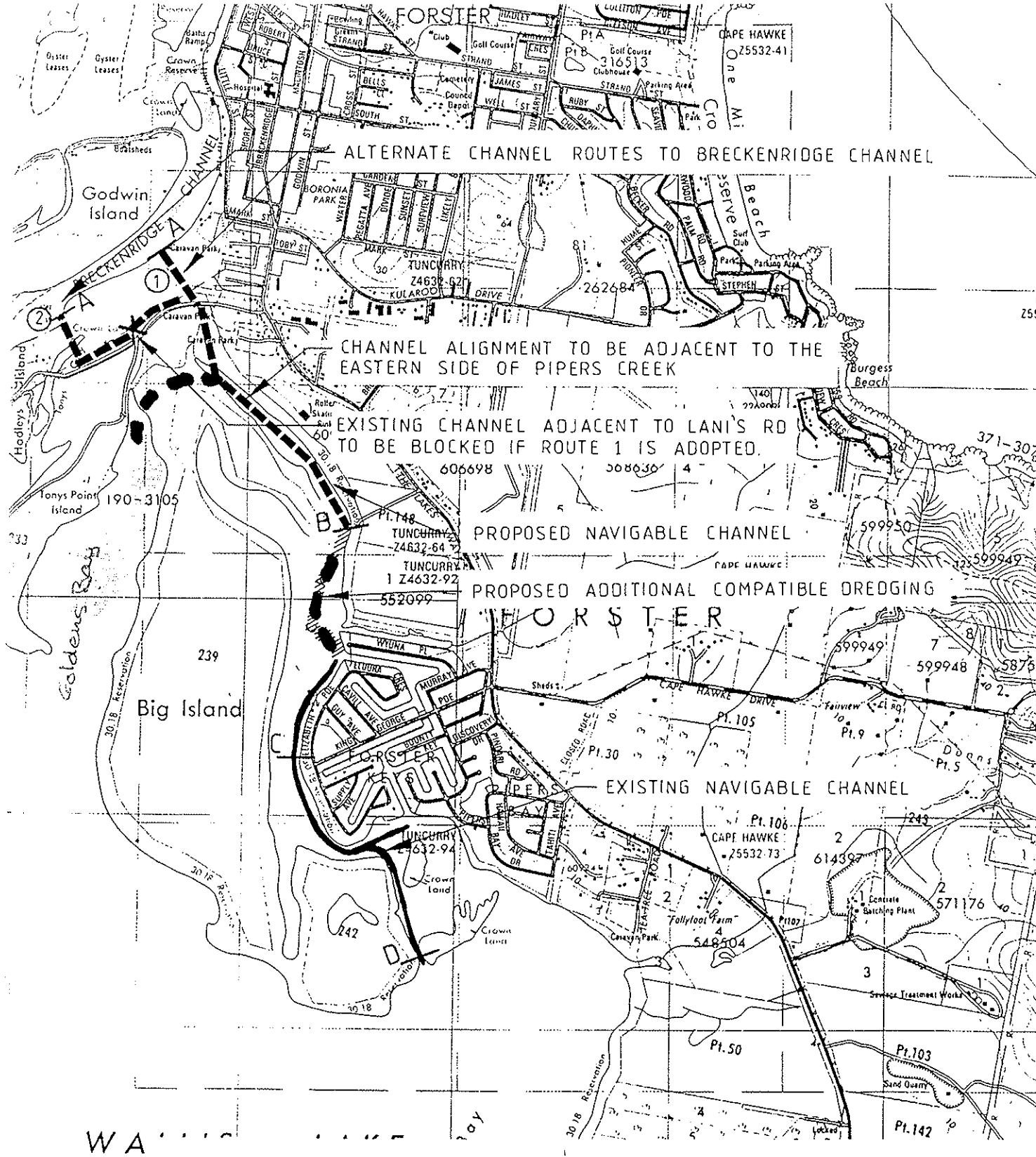


Figure 4 – Proposed Lower Breckenridge Channel dredging
GPS Coordinates

1	32° 11' 36.81"	152° 30' 33.80"
2	32° 11' 46.23"	152° 30' 23.32"
3	32° 11' 50.70"	152° 30' 12.83"
4	32° 11' 57.96"	152° 30' 03.80"
5	32° 12' 00.70"	152° 29' 58.26"
6	32° 12' 01.02"	152° 29' 52.42"
7	32° 11' 58.03"	152° 29' 44.56"
8	32° 11' 59.84"	152° 29' 40.29"
9	32° 12' 02.71"	152° 29' 35.84"



TYPICAL CHANNEL SECTION

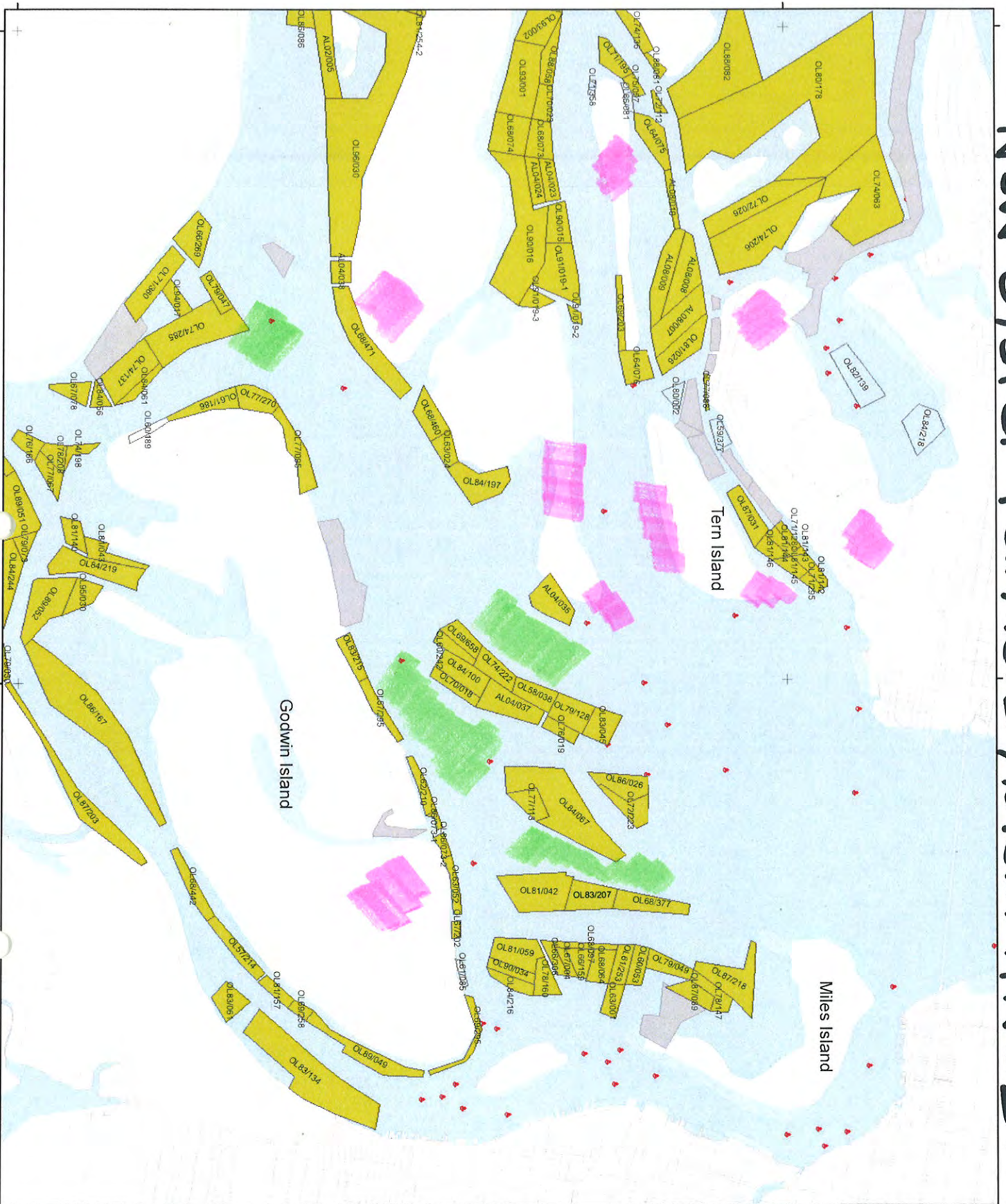
NAVIGABLE CHANNEL OPTION - LAYOUT

FIGURE 7

NSW OYSTER FARMERS ALTERNATIVES.

Aquaculture leases in
WALLIS LAKE -
GODWIN ISLAND

lease status as
of JULY 2010



- Legend**
- current
 - former
 - Historical Leases (unsurveyed)
 - navigation markers
 - Cadastral boundaries
 - water



Source: 1 & 1 NSW, DECCW, LMPA & NSW Maritime
Datum: Geocentric Datum of Australia (GDA)
Grid: Mapping Grid of Australia (MGA94)

The State of New South Wales, 1 & 1 NSW, its employees, officers, agents or servants are not responsible for the result of any actions taken on the basis of the information contained on the map, or for any errors, omissions or inaccuracies that may occur on this map.

Prepared by GIS section, Aquaculture Management Branch, Division of Fisheries, Compliance and Regional Relations, 1 & 1 NSW.
JULY 2010



Potential Dredge Site

Potential Disposal Site

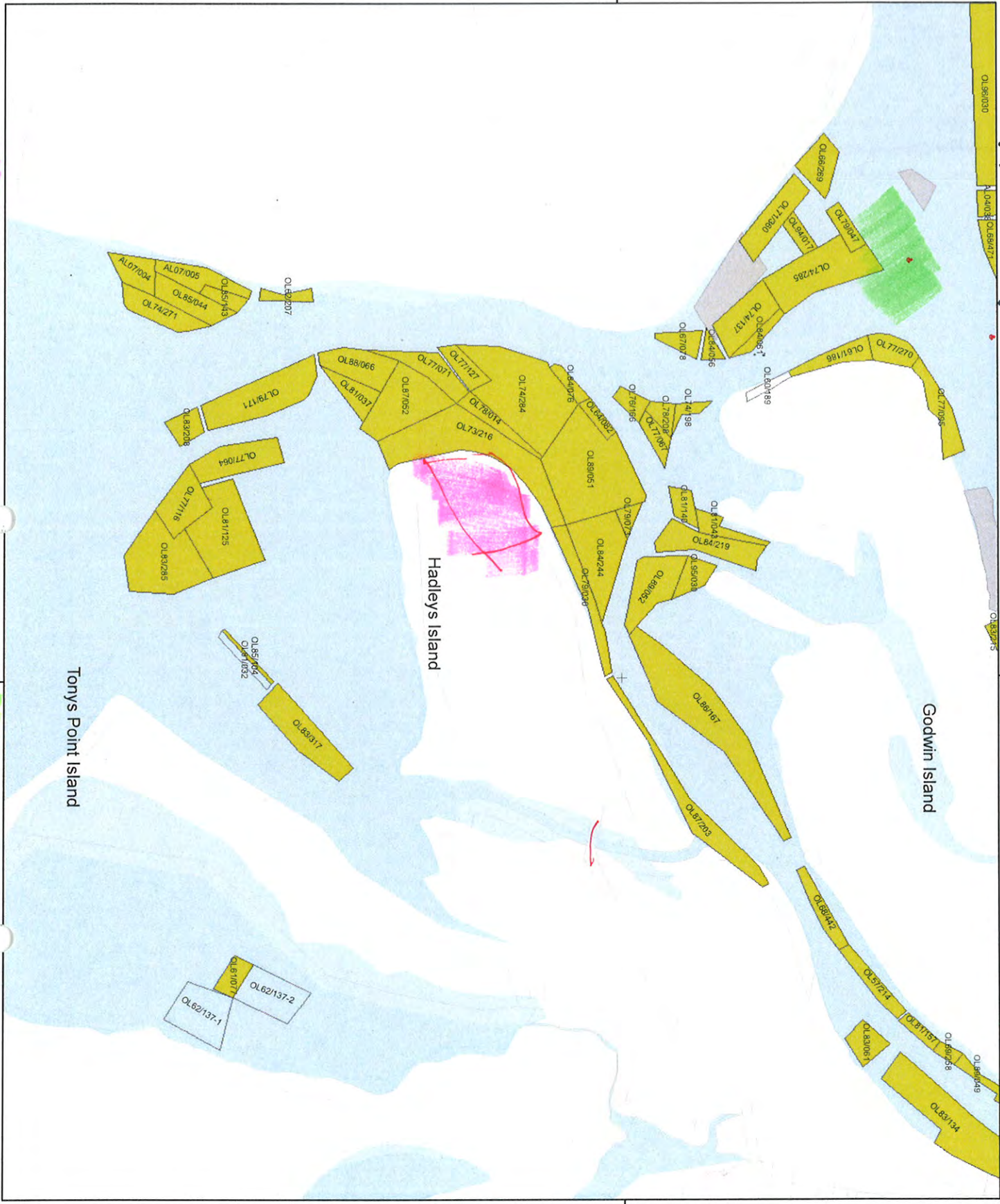
152°29'E

152°30'E

32°11'S

32°11'S

NSW Oyster Farming Alternatives



Aquaculture leases in
WALLIS LAKE -
HADLEY'S ISLAND
lease status as
of JULY 2010

- Legend**
- current
 - former
 - Historical Leases (unsurveyed)
 - navigation markers
 - Cadastral boundaries
 - water



Source: I & I NSW, DECCW, LMPA & NSW Maritime Datum: Geocentric Datum of Australia (GDA) Grid: Mapping Grid of Australia (MGA94)

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Prepared by GIS section, Aquaculture Management Branch, Division of Fisheries, Compliance and Regional Relations, I & I NSW, JULY 2010



Potential disposal.

Potential dredge site

Feasibility Study for Nourishment of Tuncurry Beach - Pipeline Options Assessment

Great Lakes Council is looking to beneficially re-use sand dredged from Wallis Lake for nourishment of Tuncurry Beach. As dredging for maintenance of navigation channels and access to oyster leases is ongoing, a permanent pipeline is proposed from the lower estuary to Tuncurry Beach, on the northern side of the entrance training walls.

The pipeline itself could include temporary floating and / or submerged sections within the Lake and buried and / or surface sections on land. The outlet at the beach could have sections of removable pipeline to distribute sand along the beach which would be spread and shaped by dozers. Following nourishment, dune restoration and revegetation could take place.

WorleyParsons has been engaged to undertake a Feasibility Study for Nourishment of Tuncurry Beach. The focus of the Study is to determine a suitable pipeline route and assess the impacts on coastal processes resulting from nourishment of a section of Tuncurry Beach, adjacent to the northern breakwater.

The Feasibility Study will determine:

- if it is feasible to pump sand onto Tuncurry Beach;
- the volume of sand Tuncurry Beach is capable of receiving initially and volumes thereafter on an intermittent basis;
- the effect / implications for Tuncurry Beach; and
- where the proposed permanent dredge pipeline would be situated and its feasibility.

Community consultation is an invaluable part of the assessment process. Obtaining the opinions and addressing the concerns of the local community who use this area is vital to a successful study outcome. All responses and enquiries would be welcomed.

For More Information Please Contact:

Katie Newton - (02) 4907 5300

katie.newton@worleyparsons.com





Our reference: DOC10/35815,
File No. FIL06/918-09
Contact: Hamish Rutherford,
(02) 4908 6824

Worley Parsons Services Pty Ltd
PO Box 668
NEWCASTLE NSW 2300

Attention: Dr Katie Newton

Dear Madam

**WALLIS LAKE – PROPOSED DREDGING OF “THE STEP” & PIPELINE OPTIONS
ASSESSMENT FOR TUNCURRY BEACH NOURISHMENT**

Reference is made to your letter dated 5 August 2010 inviting the Department of Environment, Climate Change and Water (DECCW) to provide comments on and its requirements for the preparation of a Review of Environmental Factors in respect of the above proposal.

Please note that water based extractive activities, including dredging, that involves the extraction of more than 30,000 cubic metres per year of extractive materials for sale or reuse are listed under Schedule 1 of the *Protection of the Environment Operations Act 1997* (POEO Act). Persons undertaking development work and/or activities listed under Schedule 1 of the POEO Act are required to hold and comply with an Environment Protection Licence.

Section 120 of the POEO Act makes it an offence for a person to pollute waters. The proposal will need to ensure compliance in this regard.

Even if the POEO Act does not require you to have a licence for the proposal, where there is a direct discharge to waters (for example, through a pipeline) or the likelihood that indirect run-off will pollute waters, you may choose to apply for a licence to regulate water pollution from that activity. You may also choose to apply for a non-scheduled activity licence if you believe that you are likely to pollute water due to the proximity of your activity to a sensitive water body. Should you chose not apply for a licence discharge(s) the water pollution provisions of section 120 of POEO will apply to all discharges to any waters from the project.

In general DECCW will not issue a non-scheduled activity licence where there is a low likelihood of impact on waters and where pollution will not occur if the activity is carried out in strict compliance with best-practice guidelines.

It is understood that the proposed dredging will be undertaken by Great Lakes Council. Irrespective of licensing requirements under the POEO Act, as the activity is to be undertaken by a public authority, DECCW will be the appropriate regulatory authority in respect of all environmental matters under the POEO Act for the project.

Please find below DECCW's comments for consideration in preparing the REF.

Water

Section 120 of the POEO Act prohibits the pollution of waters. The REF should provide sufficient information to demonstrate that the proposal can be undertaken in compliance with section 120 of the POEO Act. In particular the proponent should identify and make provision to manage the risks associated with turbidity from the dredging activity; the smothering of aquatic fauna and flora including seagrass from the settling of suspended solids; and impacts from the disturbance of acid sulphate soils.

Documentation presented should address the water quality objectives of the receiving waters, characterise the quality of water likely to be discharged and detail appropriate safeguards and water quality management practices. DECCW has adopted the 'Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC, 2000)' as a guide for the assessment of environmental impacts on aquatic ecosystems. The proposal should be consistent with the guidelines provided in the ANZECC 2000 document.

Air

Sections 124-128 of the POEO Act prohibits air pollution. The REF should provide sufficient information to demonstrate that the proposal can be undertaken in compliance with sections 124-128 of the POEO Act.

Noise

The potential noise impacts associated with the proposal should be assessed and conform to the following guidelines:

- EPA's *Industrial Noise Policy*;
- DECCW's Interim Construction Guideline; and
- EPA's *Environmental Criteria for Road Traffic Noise*.

Waste

All wastes from the project must be classified and disposed of in a lawful manner. DECCW's *Waste Classification Guidelines, Part 1 – Classifying Waste* provides guidance in this respect.

Threatened Species and Aboriginal Cultural Heritage

In addition to environmental matters under the POEO Act, the REF will need to assess the potential of the proposal to impact threatened species, their habitats, and endangered ecological communities; and, areas of Aboriginal cultural heritage significance. DECCW's website makes available guidance information for undertaking threatened species and Aboriginal Cultural Heritage assessments.

If you require any further information regarding this matter please contact Hamish Rutherford on (02) 4908 6824.

Yours sincerely



13 AUG 2010

MARK HARTWELL
A/Head Regional Operations Unit - Coastal
North East Branch
Environment Protection and Regulation



2 August 2010

Ref: 301020-02712

Contact
Organisation
Address

Dear

Wallis Lake - Proposed Dredging of 'The Step' and Pipeline Options Assessment for Tuncurry Beach Nourishment

Proposed Dredging of 'The Step' Wallis Lake

'The Step' is a large, active migrating sand shoal located between Wallis and Tonys Point Islands in Wallis Lake. The navigation channel associated with 'The Step' provides the main access for commercial and recreational boats travelling from the estuary entrance and boat ramps around Forster / Tuncurry to Forster Keys, Green Point and the southern section of Wallis Lake. A number of commercial oyster leases fringe the shoreline in this section of the estuary. Photographic evidence indicates that 'The Step' has migrated upstream into the Lake by up to 200 m over the last 30 years, with hydrographic records and anecdotal information indicating a shallowing of the area. The migrating sand shoal is currently encroaching on seagrass beds (*Posidonia australis*). In 2005 NSW Maritime removed channel markers in the area, as safe navigation could not be guaranteed.

Great Lakes Council proposes dredging of 'The Step' and associated channels to:

- enable the waterway to continue functioning as a tidal waterway;
- reinstate safe navigation; and
- possibly provide a source of fill material for future development.

WorleyParsons has been engaged to undertake a review of environmental factors (REF) for the proposed dredging works.



Location of 'The Step' - Wallis Lake

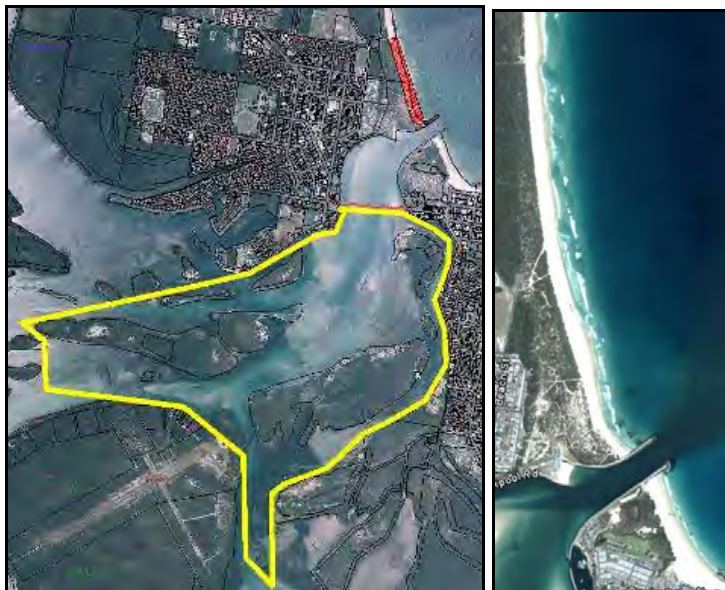


Feasibility Study for Nourishment of Tuncurry Beach - Pipeline Options Assessment

Great Lakes Council is looking to beneficially re-use sand dredged from Wallis Lake for nourishment of Tuncurry Beach. As dredging for maintenance of navigation channels and access to oyster leases is ongoing, a permanent pipeline is proposed from the lower estuary to Tuncurry Beach, on the northern side of the training walls. The pipeline itself could include floating and / or submerged sections within the Lake and buried and / or surface sections on land. The outlet at the beach could have sections of removable pipeline to distribute sand up and down the beach which would be spread and shaped by dozers.

WorleyParsons has been engaged to undertake a Feasibility Study for Nourishment of Tuncurry Beach including a Pipeline Options Assessment. The focus of the Feasibility Study is to determine a suitable pipeline route and assess the impacts on coastal processes resulting from nourishment of a section of Tuncurry Beach, adjacent to the northern breakwater. The Feasibility Study will determine:

- if it is feasible to pump sand onto Tuncurry Beach;
- the volume of sand Tuncurry Beach is capable of receiving initially and volumes thereafter on an ongoing basis;
- the effect / implications for Tuncurry Beach; and
- where the proposed permanent dredge pipeline would be situated and its feasibility.



Location of Wallis Lake potential dredge areas and nourishment site on Tuncurry Beach.

We are currently seeking comments and advice from all relevant stakeholders to assist in identifying key issues and concerns associated with the proposed dredging of 'The Step' and the Nourishment of Tuncurry Beach Pipeline Options Assessment.



WorleyParsons

resources & energy

We would be interested in obtaining the following information:

- environmental concerns;
- information on navigation depth requirements for recreational / commercial boating;
- information on waterway and foreshore recreational / commercial use;
- potential impacts of dredging operations on commercial operations (short-term during dredging and long-term impacts through changes to navigation channels and associated side effects);
- potential impacts of dredging operations on short-term and long-term recreational use;
- potential impacts of the proposed pipeline on commercial operations, recreational use and environmental values.

Concerns raised by stakeholders would be addressed in the REF and through 'design' of a preferred pipeline option.

We will be available to discuss any issues with interested stakeholders in Forster / Tuncurry on Wednesday 18th (late morning – evening) and Thursday 19th (morning) of August 2010. If you are interested in arranging to meet with us on either of these days please let us know as soon as possible, indicating your preferred date / time, email address and contact number.

We look forward to your response.

Kind Regards,

Dr Katie Newton

Marine Ecologist
WorleyParsons
Newcastle East

katie.newton@worleyparsons.com
Ph: (02) 4907 5300
Fax: (02) 4907 5333

Alternatively, you may contact Heather Nelson on:

heather.nelson@worleyparsons.com
Ph: (02) 4907 5300
Fax: (02) 4907 5333

Wallis Lake Fisherman's Cooperative – Consultation

Meeting: 11 am, Wednesday 18th August 2010.

Present: Peter Ragno (vice chairman), Pauline Tatam (Operations Manager).

Pipeline Feasibility Study & Options Assessment:

Access:

Access along the entire foreshore could be a problem if a land based pipeline option was to be implemented without trenching. The entire foreshore along Point Rd is made up of car parking for access to the boat ramps and moorings which run along this area. Access issues for both cars and boats would arise. The pipeline could not be run along the other side of Point Rd as this consists of residential development and the same car access issues would occur.

There are two boat ramps at Boatland Marine on Point Rd, a boat ramp in front of the Fisheries office and a slipway at the Wallis Lake Fishing Co-operative. In these areas the pipeline would have to be trenched under the ramps or go out and around these ramps (in enough depth that boats or trailers would not disturb or become caught on the pipeline). In the case of the slipway, trenching would not be possible and the pipeline would have to run out and around it (the slipway tracks run approximately 30 m out from the edge).

Positioning:

Any pipes which are run in the water should be placed on the very bottom of Wallis Lake rather than along the edges near the Wallis Lake Fisherman's Co-operative to avoid boat collisions. However, the strong currents would have to be taken into account and the pipeline weighted accordingly.

Land Ownership:

The Wallis Lakes Fisherman's Co-operative has a 20 year lease on all the moorings along the shoreline near the Co-op and along Point Rd, the land and car parking surrounding the Co-op and around the slipway.

Commercial Fishing Activities:

Beach hauling for Mullet occurs along Tuncurry Beach from April to June each year. Any pumping of sand onto the lower areas of the beach or into the water should not occur during this time as it will cause major disruption to the fishery (as fish migration will be disturbed by noise created with use of machinery on the beach).

Alternative Options:

Sell the sand instead – Tuncurry Beach is bigger than it has been in many years. Sand dredged from Wallis Lake has in the past been pumped to a parkland site on Point Rd before being taken away for use as fill.

Other Issues:

The Wallis Lake Fisherman's Co-operative would like to be informed before any pipeline laying is undertaken so they can arrange to be on site and assist in placement positioning so as to cause the least possible disruption to their operations.

Proposed Dredging of The Step:

Dredging of The Step is not necessary for the Wallis Lake Fisherman's Co-op as it does not pose a hazard for the navigation required for commercial fishing activities that occur in that area.

Commercial Fishing Activities:

Commercial prawning occurs throughout the channel (Stockyards) which runs to The Step. Nine permanent prawn pegs are in place along the eastern side of this channel from which ropes and nets are set out to the western side to trees / poles. If pipelines are to be used to remove the sand from dredging activities at The Step they must not be floating, they will have to run along Wallis Island (at least 10 m in behind the tree line).

Prawning occurs all year here with the exception of the months May to July. There is also less recreational fishing occurring at this time. The best time for dredging in this area is therefore in winter (May to July).

Dredging Options:

If any channel should be dredged it should be the western channel which is currently used. And if this channel is dredged the outer point (end of) of The Step should also be taken removed or this sand will eventually fill in to the newly dredged channel. Do not touch any of the naturally formed "lumps and bumps" which are currently being colonised by seagrass in some areas, just dredge and deepen the naturally formed western channel.

Hells Gate:

The Wallis Lake Fisherman's Co-operative is strongly opposed to dredging of 'Hells Gate' as it currently creates an important buffer against the tide. With the removal of 'Hells Gate' they believe that the tidal flow will change, turning already strong currents into dangerous currents which will "rip through" the area, potentially causing damage to the oyster leases upstream and downstream of it and creating further erosion issues. They believe that 'Hells Gate' has been the same way for 30 years.

Peter 12 noon

- step has moved about 200m in recent years, moving to eastern channel
- gutter at Hell's gate has not changed in 30 years – current gets up to around 3knots
- Booness??? channel sand bank has grown
- there hasn't been any dredging for at least 10 years

NSW Maritime – Consultation

Meeting: 12.30pm, Wednesday 18th August 2010.

Present: Bret Ryan.

Pipeline Feasibility Study & Options Assessment:

Navigation Issues:

Any pipelines which are laid in the water need to be at adequate depth as so they do not create a navigation hazard. In addition, if any pipelines are laid across waterways “No Anchoring” signs will have to be erected as to prevent boats from anchoring and ripping up the pipe.

Due to localised currents at the entrance, if sand from the pipeline is pumped into the water on the northern side of the break wall it will possibly re enter the entrance channel and the lake, possibly causing a navigation hazard.

Pipeline preference is for along the bottom rather than on land or floating.

Pipeline Intake Locations:

A pipeline intake location is suggested by Maritime for the tip of Tern Island, with the pipeline running down the centre of the channel (at a depth of 2 m) in the area adjacent to Point Rd (which is not a good place for pipeline logistically) before joining to the foreshore. This area would have to be made a “No Anchoring”.

The pipeline could run along the base of the training wall from near Boatland Marine along the Tuncurry foreshore above the high tide limit. This would reduce the extent of “No Anchoring” and also decrease the possibility of recreational fishermen fouling their lines when fishing from the foreshore.

Alternative Options:

Council has previously looked at on selling sand as an option rather than beach nourishment however LPMA wanted royalties.

Term Island has previously been looked at as a storage site for the sand.

There is a network of stormwater drains near Tuncurry Beach which could possibly be used to cross the pipeline over the road with appropriate permission.

Proposed Dredging of The Step:

Maritime is in favour of any works which enhance waterway and recreational use of Wallis Lake.

Navigation:

Proposed dredging of The Step will result in short term navigation issues and channel restrictions in the area.

Maritime is about to install two new starboard navigation channel markers at The Step. There are no records of the exact positions of the old channel markers which were removed in approximately 2002. Two markers are currently in place at The Step.

If The Step is to be dredged the western more natural channel is the preferred option. However, all seagrass around the channel should be avoided.

The eastern channel option may be feasible if the channel is cut through south of the last oyster lease rather than continuing downstream between the leases. This option would require less removal of spoil and provide access to water of 2 to 3 m.

Most boat traffic through here which may require dredging works to be undertaken consists of large boats from Forster Keys and Pipers Point. Any channel to be dredged should be at least 2 m deep and 30 m wide in accordance with recent dredging works which have been undertaken in Wallis Lake for similar navigation issues.

Any pipeline used to pump sand from The Step should be run along Wallis Island or completely sunk (floating pipelines are not seen as a viable option). The prawn pegs and oyster leases in this area will cause a navigation issue in relation to laying the pipeline in the water. Laying the pipeline outside of the prawn pegs or within the boundary of the oyster leases may reduce impacts on navigation.

Dredging should occur in the winter months – this would avoid much of the recreational boating traffic which occurs in the summer months and will avoid the stronger tides which occur in the summer.

Hells Gate:

Maritime has suggested that rather than dredging 'Hells Gate' the oyster leases on this corner could be removed. The leases currently lie over the deepest section of this channel and are in the natural channel forming area. Maritime has proposed that there may be the possibility of Maritime paying for removal of the existing oyster posts (however, this will need to be discussed further and confirmed). The oyster leases here are currently used very little and due to the strong currents running around this corner are not especially productive. This option would need to be discussed with the oyster farm leaseholders.

Other Issues to Address:

Potential acid sulphate soils – these are especially an issue for the surrounding oyster leases.

Commercial fishing activities e.g. oysters leases, prawn fishery.

Official Requirements:

Commercial Vessels Act – All dredgers and contractors are required to hold the appropriate licences and qualifications.

Marine Safety Act – All marine obstructions must be clearly marked and authorised. Pipelines will need to be marked and channel markers erected during dredging operations.

Marine Notice – A notice will be required in the local papers (in advance of the works) to notify all waterway users of changes which will be occurring to the waterway and navigation channels. This can be done by Maritime or Council.

Speed Restrictions – Short term speed restrictions (4 knot speed limits) will be required around the dredge area and any equipment during dredging and pumping activities.

No Anchoring Zones – Will be required in any place where a pipeline has been sunk for temporary or permanent sand pumping activities.

Industry & Investment NSW - Fisheries – Consultation

Meeting: 3.30 pm, Wednesday 18th August 2010.

Present: Martin Angle.

Pipeline Feasibility Study & Options Assessment:

Navigation:

NSW Fisheries supports the pipeline inlet option which was suggested by NSW Maritime (i.e. an inlet at the eastern end of Tern Island with the pipeline running along the bottom of the channel towards the ocean until the bridge, where it could then run alongside the break wall).

As currently mapped, the pipeline would encroach onto areas of seagrass running adjacent to Tern Island. This pipeline option may also have an impact on oyster farmers who launch their vessels from this area (along Point Rd) and the commercial fishing moorings located here.

The pipeline should not impede on launching of the Fisheries vessel from the Fisheries boat shed. Any pipeline would have to be run either underneath the boat shed ramp against the wall or deeper out on the bottom of the lake.

Protected Species:

Seagrass occurs in vicinity of Tern Island.

Protected Estuary Cod occur in the vicinity of the Forster-Tuncurry Bridge (near the Fisheries boatshed).

Deposition Site:

Clarification is needed as to the deposition site – offshore / on sand dunes?

The sand dune deposition site will need to be clarified and the site assessed.

Clarification of how the dumped sand will be distributed will be required. Will it rely on natural processes or will equipment be used? What will be the impact of this on the dune habitat?

No dumping of sand should be undertaken during the Tuncurry Beach Mullet run.

Long term considerations regarding beach shaping and seafloor shaping need to be addressed. Any changes to the seafloor topography could impact upon the Mullet run.

Proposed Dredging of The Step:

Commercial Fishing:

A commercial prawn fishery occurs in the main channel running upstream of The Step. Nine prawn pegs are located along this channel. Commercial prawning is undertaken using a set pocket technique.

Commercial crab trapping occurs in the main channel here.

Commercial meshing activities occur in the channel and around The Step (gill netting). There is also a commercial fish hauling shot which is located near to the eastern end of Dago Island and runs over The Step (Reece Chapman - Fisherman's Co-operative).

Recreational Fishing:

Recreational prawning occurs in the channel by use of scoop nets.

Recreational crab trapping occurs.

Recreational angling occurs.

Hells Gate:

Dredging of 'Hells Gate' could be a problem as removal of this sand plug could cause massive currents around this corner. These currents will in turn have impacts on the prawn fishery in this channel.

There are a number of oyster leases around this corner which are currently not used to their potential and harvest very few oysters (in part due to the currents which run through this area). Removal of the oyster leases at this corner is considered to be preferable to dredging here. The leases are currently zoned a "Priority Aquaculture Area". There is the possibility that the boundary of the leases could be modified or a portion of the lease could be purchased to allow removal or the existing lease for navigation purposes around this corner.

Dredging The Step:

Dredging of The Step will cause flow rates to increase on the run in and run out tides. These flows will have potential issues for erosion and the oyster leases on the area. Increased tidal flows may also impact on the prawn pegs which are located in the channel and the way in which the prawn fisherman undertake their work.

Ecological Considerations:

Seagrass – increased flow rates through the western channel and a result of channel deepening may have an impact on the Posidonia beds (which are located adjacent to The Step) through increased erosion and scouring. A buffer zone would need to be incorporated into any new channel design. Once dredged the new channel should be marked to prevent impacts on seagrass surrounding it.

Benthic invertebrates - address the impact on benthic invertebrates residing in the sediment to be removed.

Protected species - Estuary Cod, seahorses and pipefish occur around the coffee rock which occurs through the channel. Turtles and dolphins are also found in Wallis Lake.

Oyster Farmers NSW – Consultation

Meeting: 4.30 pm, Wednesday 18th August 2010.

Present: Steve Verdich, Anthony Sciacaccas.

Pipeline Feasibility Study & Options Assessment:

Oyster Farmers mentioned that the Land and Property Management Authority (LPMA) has a foreshore Masterplan for Forster Tuncurry - this should be referred to before any pipeline routes are finalised.

Will a booster pump be required every 1000 m?

Cost:

What will be the charge to use the line? i.e. the cost to oyster farmers when undertaking maintenance dredging – this cost needs to be feasible if the pipeline is to be used by the oyster farmers.

Cost of a permanent deposition site: what is the cost of the bulldozing that will be required on the beach? Who pays for all this? The money could be used to dredge other areas in need.

Sand should be seen as a *commercial asset*. The sand dredged from Wallis Lake could be sold on a routine basis rather than being pumped to the beach. This would make money and save money at the same time. Five years ago they were offered \$30 - 35 / m³ for sand.

Oyster Farmers are prepared to undertake small maintenance jobs if it is financially feasible – if they are required to use a pipeline which is too costly it is not worth it.

Alternative Deposition sites:

Tern Island – the Oyster Farmers believe this is the most feasible and economical deposition site. This southern side of this site has been used for deposition in the past; however, much of this has since washed away.

Mather Island – the eastern end of Mather Island should be used as a deposition site to maintain the barrier which currently separates the three main oyster harvest areas which are affected by different inputs (i.e. Ocean, Wallamba River and Wallis Lake). The end of Mather Island especially protects the central oyster growing area known as “The Paddock” where oysters are grown to size. This point needs to be nourished to maintain the border between the three harbour zones and is very important to keep water in “The Paddock” clean. The Wallamba River water which flows along the northern side of Mather Island is more polluted than that flowing on the southern side in “The Paddock”. Deposition used to occur at this site and the point (Cable Point) used to be approximately 200 m longer and 6 ft higher. However, the island has now been zoned as a SEPP 14 wetland. The Oyster Farmers do not agree with this zoning saying that the end of the island has only formed due to past dumping of dredge spoil. They have mentioned this in the past to Council and LPMA but nothing has been done to change the zoning. Oyster Farmers see “The Paddock” as the most important area for oyster growing in Wallis Lake.

Developments – use sand as fill for developments. More cost benefit.

Oyster farmers have indicated numerous other deposition sites in Wallis Lake that have been used in the past (see the oyster lease maps).

Proposed Dredging of The Step:

Oyster Farmers do not believe that dredging of The Step is necessary and believe that there are multiple other areas in Wallis Lake where dredging should be concentrated, especially around the oyster leases - "why concentrate on a few larger richer boats when an industry that has been here for 80 years is being destroyed?". Oyster farmers lose income through not being able to use their leases once silted up by sand. They do not want Council to lose site of other issues and areas that require work.

Oyster Farmers do not believe that enough sand is proposed to be dredged from The Step to make it a worthwhile exercise cost wise. They believe that if sand is to be removed from here the entire section should be removed.

If dredging is to occur it should be undertaken when harvesting occurs (October to March).

Oyster Farmers were told by Council that they could input data on dredging of their leases into the hydrodynamic models to see what changes would occur if certain areas were dredged.

The oyster leases on the corner where "Hells Gate" is located are deepening due to the strong currents around this corner. This is making the leases on this corner almost unusable and many of the poles are becoming encrusted with fouling organisms such as ascidians e.g. Pyura. These corner leaseholds are owned by Brian Lauff and MS Verdich and Sons – there is the potential for removal of these leases to create navigation channel with appropriate compensation.

Steve Verdich has been told by Council that discussion would be made as to feasibility of a pipeline from The Step directly east to behind the Tavern for pumping dredge spoil. Steve was told he could potentially piggyback the pipeline and dredge some of his leases out at the same time.

Boatshed No. 1 – Consultation

Meeting: Thursday 19th August.

Present: Bob Watson.

Pipeline Feasibility Study & Options Assessment:

No comments on the pipeline layout.

Proposed Dredging of The Step:

No concern for loss of seagrass as thinks that it will “just grow back around the corner”.

He believes that the Western Step is building up and this is also of high priority to dredge – especially for his business as this is the path which he takes into the lake.

Houseboats need just 2 ft water.

Access to the lake during dredging was a major concern (i.e. would access be restricted by floating pipelines?).

Dredge spoil should be given to Nino Lani for building up his land – Nino has offered to dredge and take the sand for free in the past.

Prior to 1961 steam dredge clearing for a navigation channel near the Forster Tuncurry bridge occurred – deposition was on the island opposite Forster.

Local Resident / Surfer – Consultation

Meeting: Phone call Tuesday 24th August 2010.

Present: Gary Angus.

Pipeline Feasibility Study & Options Assessment:

Gary is a local resident who has surfed Tuncurry Beach his entire life.

Gary says that during the winter months people do not surf Tuncurry Beach as the beach becomes deep and dangerous (for this reason he does not think we will get much comment from surfers who use the area as they are not using the beach at this time). He believes this is in part due to the fact that the sand which is transported onto the beach during the summer months by natural processes is not being brought back into the water during winter as a result of Dunecare activities and revegetation activities (which essentially trap the sand).

Dune care was originally implemented here to stop sand blowing into the car park but has changed the natural sand movements of Tuncurry Beach (i.e. that sand is transported onto the beach by wind and waves during summer and is returned to the water during the winter months). He also believes that the vegetation is full of rabbits and snakes.

While Gary believes it is a great idea to pump sand onto the beach he believes there are a number of issues which would make this exercise a waste of time:

- Sand is currently transported from the southern end of Tuncurry Beach around the break wall into the swimming enclosure. Every summer Council removes “at least 100 x 10 tonne trucks” of this sand and does not replenish the beach with it – why not when it is so close? It is a waste of money to pump the sand with a permanent pipeline when eventually it will end up in the enclosure and Council will simply truck it away.
- Unless Council extends the break wall extensively (as Gary says was supposed to be done but it was only slightly extended) the sand will continue to move into the swimming enclosure.
- Bennett’s Head at Forster is in much greater need of sand replenishment than Tuncurry – could this be an option?

Proposed Dredging of The Step:

No opinions on this matter.

Land and Property Management Authority

Meeting: Thursday 19th August 2010.

Present:

Stephen Driscoll – State Manager Minor Ports

Chris Atchison – Program Manager Commercial Mid North Coast Region

Bob Birse – Team Leader Land Management Mid North Coast Region

Forster-Tuncurry Crown Harbour Project:

- new harbour (30 year project) takes out caravan park, has vehicular and pedestrian bridges, fishing coop relocated to western side of new harbour
- pipeline could be installed on vehicular bridge across proposed harbour
- propose removing fore & aft moorings at Forster – new moorings near Tern Island – dredging required
- Tern Island continued to be used as a dredged sediment stockpile site for next 15 years (proposed bridge link from island) then developed as a camp ground – bridge should address neighbourhood noise concerns as material could be trucked north-east along Point Rd affecting fewer properties – original EIS involved trucking to reserve at western end of Point Road

- Co-op jetties LPMA licences, 5 to the eastern side licensed directly to fishermen with the rest licensed to the Coop
- Fazio Park is Crown land vested in Council, land east of bridge is Council freehold, there is a 100ft foreshore reserve around most private land
- runway still operates on Wallis Island

- May 2009 storm – water overtopped sand bar (“Coop Island”) adjacent to entrance channel and moved sand around to Point Road bar on southern side of bridge
- dune is OK apart from low spot – dredged material could be used there or considered for higher use e.g. land fill or for making concrete (as per Swansea Channel)

Other dredging proposals:

Trevor Dent’s proposal – oyster lease last dredge in 1981 - pipe from Oaky Island up Wallamba River entrance to a processing site at Chapmans Road, and use for landfill or sell sand (includes 3 booster pumps)

Free Spirit Cruises

Meeting: Thursday 19th August 2010.

Present: Peter Mannow

Proposed Dredging of The Step:

- operates largest commercial vessel on Wallis Lake (*Amaroo* only goes around entrance area and out to sea)
- goes out 5 to 6 nights a week in the 6 weeks before Xmas
- *Spirit* has 8ft draft
- when fully laden and on low tide, Hell's Gate is a bit tricky
- if The Step channel was a little deeper it would eliminate the element of risk
- seagrass at Hell's Gate
- The Step channel has been deepening the last couple of years
- crossed Hell's Gate at around noon with 1.6m clearance, The Step at 12.10 with 1.9m clearance (about ½ low tide)
- uses western channel to cross The Step
- about 5 years ago sand bar?? closed off in heavy rain
- last 12 months sand has built up on shoals between the Paddock and Mather Island
- Wallis Lake – blue swimmer and mud crabs, 30% of NSW oyster production worth \$14M, prawning Sept-April
- swamp land has been bought back and filled (acid sulphate soils) and water quality has improved, for last 31/2 years there has been no requirement to purify oysters
- Wallis Island was prime recreational area between 1949 & 1969 – flights from Sydney
- Breckenridge/ Barclays
- there is little boating on Wallis Lake - typically sees 2 or 3 boats fishing on The Step during busier periods (weekends, holidays) – from September onwards there are more boats using the lake including cruisers
- kayaking and canoeing has become popular in the last couple of years
- has seen turtles a couple of times, Bottlenose Dolphins sighted regularly, dugong sighted once (confirmed by NPWS), a seal sighted years ago, Hammerhead shark around bridge (haven't sighted sharks in Wallis Lake),
- Recreational fishing in Wallis Lake for bream, flathead, whiting, luderick and leather jackets

Blue Peter Boatshed

95 Little Street

Phone Call: Monday 23rd August 2010.

Present: Helen and Warner? Nixon (have had business for four years)

Proposed Dredging of The Step:

- have 7 hire boats, 4.3m seaowl? boats with 6 horse power outboard motors which can do 10 knots (mainly hired for recreational fishing) and boats use their mooring during holiday times (trailerable boats) – also hire out kayaks
- entrance to the channel access to the boatshed is silting up – they have put in 2 white buoys to guide hire boats – sometimes have to lift motor out of the water to for access
- sand bars are silting up around Leon and Goodwin Islands
- Breckenridge Channel is shallow on low tides
- also shallow further out towards oyster leases (the paddock?) and bridge
- large boats can't get out the top end of Breckenridge Channel near oyster shed

Frank Atchison

Dune Care

Meeting: Wednesday 1 September 2010.

DuneCare Works/ coastal processes

- have moved dunes further forward, shoreline used to be located at approximately the eastern side of the carpark at the entrance pool
- originally the breakwater was only constructed to the corner of the pool
- late 1950s/ early 60s the breakwater was extended in the to assist the commercial fishing fleet
- the tide sucks out sand up to? the bridge area and then drops it on the entrance bar and the same sand comes back into the beach at the pool – the training wall on the southern side of the pool was built to create a sand trap
- Council removes sand from the pool
- since the 1960s sand from the bar has also moved to the northern side of the breakwater and this area has gradually built up
- since 1970s the dune area has grown and moved forward
- prior to dune stabilisation, sand blew into and covered the carpark
- in 1991 marrum grass (as recommended by PWD at the time) was planted to stop sand drift on the dunes, French millet was planted in the picnic areas
- foredune, swale, secondary dune was constructed by Council
- swale area is too wide, and bakes as the NE goes over the top of the foredune and the swale area doesn't receive any breeze – consequently it has taken a while to get plants to grow in the swale
- since 1990s there hasn't been much change in the dune
- primary dune is very narrow just north of the accessway, a fence has been installed to try to collect sand – a big sea could break through in this location and flood the swale
- 4-5 years grown out
- to south fo area berore bit that's built on
- stabilise over 20 years
- snd built up where fence is – personal opinion
- 4WD access
- navigation channel (Mathew Legget? 20 years ago) – 100m off Tuncurry Channel, dredged once since
- long liner got stuck on training wall
- ebb tide runs at 7 to 8 knots
-

Deposition of dredged material on Tuncurry Beach

- dunecare have installed watering system (plastic hose) – could be moved if required for pipeline route
- sewerage pumping station
- sand could be placed behind foredune to reduce swale width and then replanted

Use of Tern Island as deposition site (personal response as local resident)

- opposed as this would lead to industrialisation of the area
- proposed bridge would block channel
- this would involve heavy machinery, sheds etc
- would create traffic problems
- need to look at ongoing disposal site for sand dredged from oyster leases

Boatland Marina

Peter and Mat Caves

Meeting: Wednesday 1 September 2010-09-23

Areas that have silted up:

- Western Step
- Hells Gate
- The Step
- sandspit just west of bridge

Mather Island is close to breaking through

The Maze – good to go through

- channel used to be 10 to 20 ft deep along Point Road
- 1927 flood – around bridge
- brock at sailing club and up at Failford

World War I – Wallis Lake was open at Tiona

1985 – breakwater was extended

1987 report – (Pat Daley PWD) 250,000 tonne of sand moves on each change of tide – 1985?

205 more water going in and out of estuary as a result of training works

Tern Island created? from sand pumped from old vehicle ferry area and the paddock –

Western end of Tern Island could take 150,000m³ of sand

there was continual dredging when the vehicle ferry was in operation

1956/ 60 sand was higher than the low level bridge (up to 3m) – had to clean sand off bridge

dredged sand used to increase height of Coop Island

suggest rockwall to east of Tern Island to create harbour (has talked with Indra (MHL) about design)

200,000m³, 300,000m³ Godwin plus Cockatoo Island (dredged sand dumped on NPWS land) could be pumped to Tern Island

Fazio Park, Pipers Creek behind school playing fields, southern parkway

1.5M m³ of sand could be available from oyster leases, navigation channels, restorations (sand dumped on islands by oyster farmers)

could use bottom dumping barge for The Step – barge sand from The Step

Brian Baker needs fill to develop land on Tea Tree Rd southern side of Folly Foot

it used to be deeper (8 ft) though the middle of The Step about 10 years ago

oyster leases impact on hydraulics

during floods sand from the Western Step is pushed around to The Step

dredging eastern channel of The Step is out

pipeline to Cockatoo Island

sale price of delivered clean sand would be \$42/ m³ and it would cost \$15/ m³ to take dredge it

current depth of channels limits boating on Wallis Lakes – during summer and Easter the Boatland Marine workshop is busy fixing bent propellers and gearboxes from visitors who strike sandbars

Scott Carter – Fisheries Nelson Bay

Dewater on Tern Island – bottom drain

noise and vibration could be addressed through using trucks fitted with airbags – would be 12 to 13 trucks/ day

there was a 'mini bar' at Tuncurry Beach 4 to 5 years ago which provided good surfing off the breakwater

SE storm in March of July 4 to 5 years ago moved sand and increased depth over mini bar

51 Point Road,
Tuncurry. 2428
24th August, 2010.

Katie Newton,
Worley Parsons,
P.O. Box 668,
NEWCASTLE.

RE: Plan to Pump Dredged Sand onto Tuncurry Beach

We are writing this letter in relation to notices that you placed on the Tuncurry dunes concerning a plan to set up a permanent pipeline for the pumping of dredged sand onto Tuncurry Beach.

We have been working on the Tuncurry Dunes and Beach every Friday morning for nineteen years and during that time we have stabilized the drifting sandhills, put in tens of thousands of plants, shrubs and trees, controlled weeds, established a permanent irrigation system, maintained fences and accessways, managed beach erosion resulting from storms, high seas and vandalism, developed a Botanic Walk as an educational and tourism facility, and built up not only a close attachment to the dunes but also a considerable depth of hands-on knowledge of the dunal and beach systems.

Before you proceed further with your plan we strongly recommend therefore that you invite our executive to your next planning meeting or that you meet with us on the site to discuss a host of issues including the preferred locations of the pipeline, the use of heavy machinery on the beach, the way in which the plan is incorporated into the proposed Tuncurry Marina and the Forster-Tuncurry Crown Harbour Project and, of course, the impact of the pipeline on our future development of the frontal and incipient dunes and the beach berm.

We look forward to hearing from you.

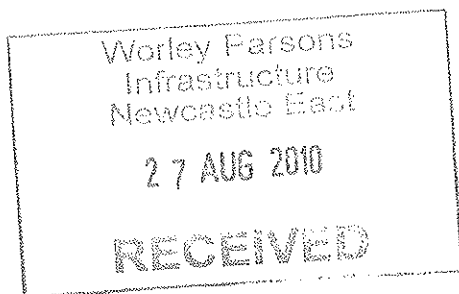
Yours faithfully,

Frank Atchison

Frank Atchison

Co-ordinator.

Tuncurry Dunecare Group.
02-65546995





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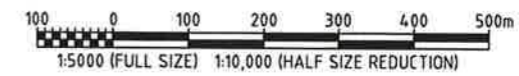
Wallis Lake Dredging and Disposal Options Assessment

Appendix B - Services



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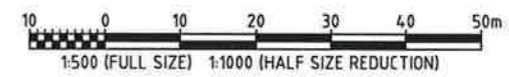
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**TUNCURRY SAND BYPASSING
ISSUE AND CONSTRAINTS
COMPILATION PLAN**

DRG No **301020-02555-CS-DSK-0010** REV **A**

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**TUNCURRY SAND BYPASSING
ISSUE AND CONSTRAINTS
DETAIL PLAN
SHEET 1 OF**

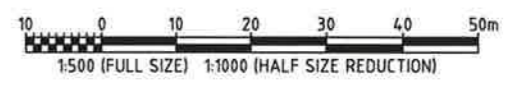
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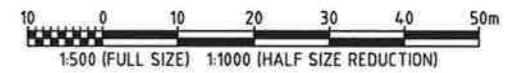
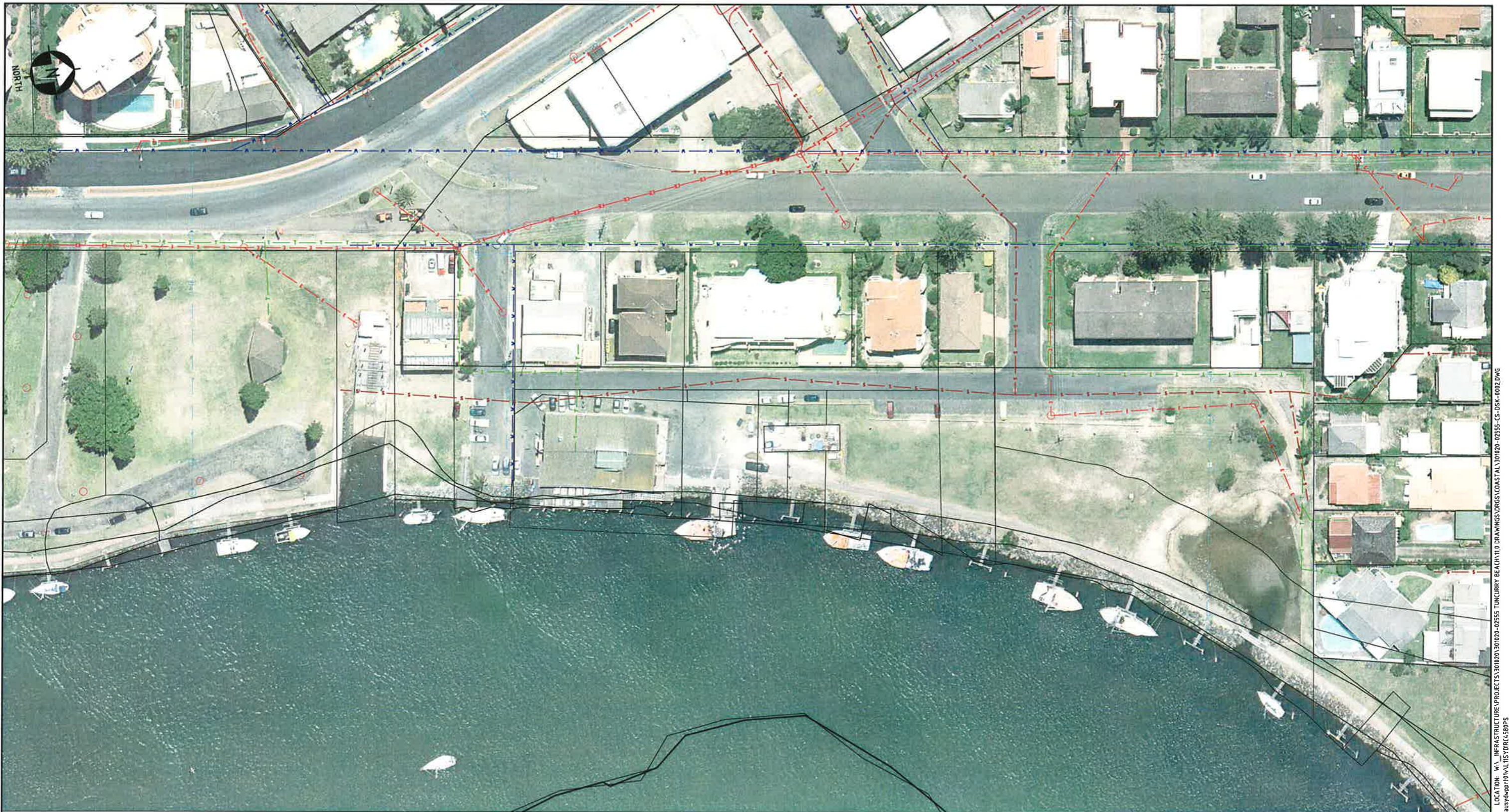
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SHEET 2 OF**

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**TUNCURRY SAND BYPASSING
ISSUE AND CONSTRAINTS
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SHEET 3 OF**

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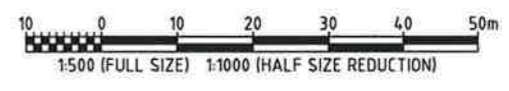
**TUNCURRY SAND BYPASSING
 ISSUE AND CONSTRAINTS
 DETAIL PLAN
 SHEET 4 OF**

 DRG No. **301020-02555-CS-DSK-0014** REV **A**



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A1 SHEET SCALE 1:500

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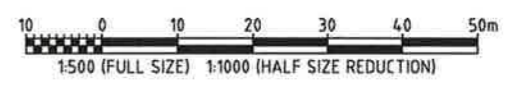
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A1 SHEET SCALE 1500	ENGINEERING AND PERMIT STAMPS (As Required)
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 CTB FILE: Worley-Full.ctb Plotter: Worley-Full.ctb

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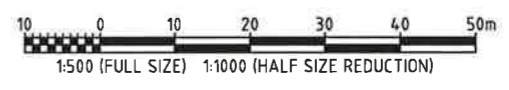
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Wallis Lake Dredging and Disposal Options Assessment

Appendix C - Coastal Processes/ Hydrodynamics Report



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Wallis Lake Dredging and Disposal Options Assessment

Appendix D - The Step Dredging REF