7 Sedimentation and dredging

7.1 Siltation in the Tamar Estuary

The Tamar Estuary has a high sedimentation rate, which results in the build-up of extensive intertidal mud-banks in the upper reaches near Launceston. This siltation seriously affects the navigation channel, limiting the size of ships which can safely pass up-river and making access to areas of the estuary beyond Rosevears more difficult. The rapid deposition of sediments has also reduced recreational opportunities and has become a major concern to the boating public and to communities surrounding the estuary, with many people considering the mudbanks unsightly. To provide for recreational boating and to maintain the aesthetic appeal of the Tamar environs, extensive dredging has been carried out in Home Reach. The natural regime of siltation and flushing in the Tamar Estuary results in a low capacity channel, which reduces the ability of the estuary to pass major flood flows (Tamar River Improvement Projects Committee, 1995).

Although the Tamar Estuary has a high rate of siltation, it is related more to the hydrology of the estuary than to the amount of sediment input - which is considered to be relatively small, for such a large catchment. Much of the problem stems from the redistribution of previously deposited silts by tidal and river flows. Sources of particulates to the Tamar Estuary include sediment supplied by the rivers, scour of old silt deposits by tide and floods, drainage from mud flats and biochemical sources of particulates within the estuary.

According to Foster et al. (1986), the tributaries of the Tamar Estuary have relatively low sediment yields, characteristic of catchments with mainly forested and pastoral land. Little coarse material enters the Tamar from the South Esk River, as the majority of the bedload is trapped by the Trevallyn Dam. The mean annual sediment load from the South Esk River has been estimated at 39, 300 tonnes. Skirving (1986) estimated that sediment loads from the smaller North Esk Basin were in the order of 3500 to 4700 tonnes.

In addition to sediments introduced to the Tamar by freshwater flows, previously deposited silts also provide a major sediment source as they are redistributed by the combined action of river flow and tides (Tamar River Improvement Project Committee, 1995). Redistribution occurs mostly in the main channel where sediments are relatively unconsolidated. An indirect estimate of the scour and deposition in the Tamar Estuary indicates that river flows in excess of 150 m^3/s will induce bed scour in the upper reaches. In general, floods flush out the upper reaches of the river, only for the sediments to be returned later by tides under conditions of low flow. The pattern of siltation or erosion throughout the estuary is therefore very dependent on the variability of river flows. Diversion of water from Great Lake in the Derwent catchment to the South Esk catchment (via Poatina Power Station) has reduced the incidence of low river flows and, as a consequence, the rate of siltation has decreased significantly. The build up of silt in Home Reach is generally around 30,000 cubic metres each year; however it may reach 100,000 cubic metres during years when flushing floods in the estuary are absent or infrequent (Tamar River Improvement Program Committee, 1995).

It is possible for tidal mudflats to act as sources of sediment to the estuary as a result of tidal drainage during the falling tide and freshwater run-off after rainfall. However intertidal sediments tend to show a high resistance to scouring due to constant wetting and drying. Mud banks are not considered to be a major sediment source to the main river channel except under

conditions of severe wave action, which may destroy the surface structure and allow more rapid scour to occur. This effect is found to be relatively small compared with tides and floods (Foster et al., 1986). Biomass growth and the 'salting out' of dissolved solids are two biochemical siltation mechanisms which occur in the Tamar Estuary, however, the contribution to siltation from these sources is expected to be low (Foster et al., 1986).

7.2 Dredging

Prior to the 1950s, the main problem resulting from siltation was related to maintaining sufficient depth and channel width for navigation purposes. However, since the relocation of primary port facilities from Launceston to Bell Bay, the principal issues have been increased risks of flooding to Launceston and the effect of siltation on the aesthetics and recreational uses of the estuary. In an attempt to minimise these problems, the area of the estuary near Home Reach has been dredged at varying levels of intensity since 1890. Initially, dredging was limited to the vicinity of Queens Wharf and the bar at the mouth of the North Esk River. There was little need for dredging in the main channel at that time, as depths were sufficient for the size of boats using the Launceston Port. As access for larger vessels became necessary from the early to mid 1900s, extensive maintenance dredging of the main channel was required. Regular maintenance dredging of the river was discontinued in 1965 when road and rail links virtually eliminated the need for large ships to use the upper reaches of the river. As a result, the estuary began to revert to its natural state with a low capacity channel and extensive intertidal mud-flats. Maintenance dredging in Home Reach recommenced over a decade ago.

The Tamar River Improvement Project Committee (TRIPC) was formed in 1988 with representation from the Tasmanian Government, the City of Launceston, the Municipality of Beaconsfield and the Port of Launceston Authority (PLA). The participating bodies agreed to contribute appropriate funds to implement a program of dredging, silt trapping and stabilisation of mudflats (Tamar River Improvement Project Committee, 1995).

Currently, the primary objectives of dredging in Home Reach are:

- to enlarge the waterway area so that peak floods are kept as low as possible thus minimising the risk of overtopping the flood levees;
- to ensure that the mud-banks do not rise above mean tide level and become too dry for scouring to occur during floods;
- to maintain the navigation channel for commercial and recreational users and maintain the access to maritime facilities - principally Kings Wharf and the Yacht Basin; and
- to improve visual amenity and access to the river.

(Tamar River Improvement Projects Committee, 1995)

Dredging and silt deposition sites

From 1987 to December 1996, the Tamar River Improvement Projects Committee has commissioned the dredging of approximately 750,000 m^3 of material from the river banks and channel upstream from Stephensons Bend (see Figure 27, Table 29) at a total cost of around $4 million. These dredging operations are predominantly maintenance dredging, removing freshly deposited silt from the river banks and channel.

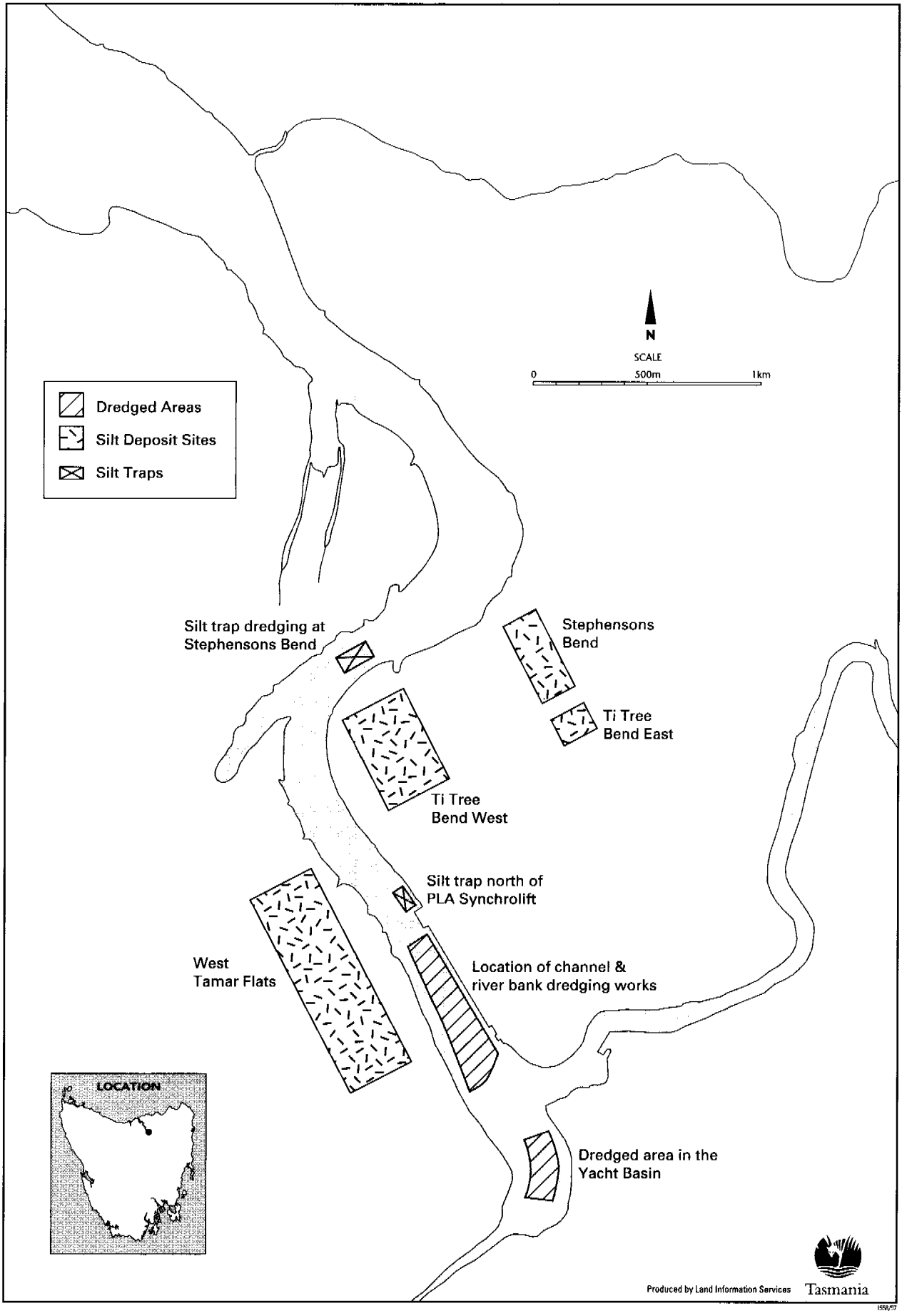

Figure 27 Dredged areas and silt deposit sites in Home Reach

Table 29 Dredging in the Tamar Estuary since 1987 - locations, volumes and costs

Contractor	Contract period	Dredge area	Dredge volume	Contract sum	Deposit area
Port of Launceston Authority	1987	East bank at the northern end of the yacht basin	10,000 m^3 (rock & silt)	$500,000	PLA land at Ti-Tree Bend East
Tasmanian Dredging Services	Jun 1988 to Dec 1990	West bank in Home Reach between the synchrolift and the North Esk River	122,000 m^3 (silt & debris)	$1,000,000	West Tamar Flats - 90,000 m^3 Ti-Tree Bend West - 32,000 m^3
Hazell Constructions	Jun 1991 to Jan 1992	Yacht Basin	50,000 m^3 (rock & silt)	$880,000	PLA land at Ti-Tree Bend East
Ron Read Dredging	Nov to Dec 1990	Stephensons Bend	12,000 m^3	$65,000	Ti-Tree Bend West
Tasmanian Dredging Services	Jul 1993 to Jan 1994	North of the Synchrolift in Home Reach Stephensons Bend	200,000 m^3 20,000 m^3	$200,000	Ti-Tree Bend West
L.D. Marine	Jan 1994 to Aug 1994	West bank in Home Reach between the synchrolift and the North Esk River	85,000 m^3	$340,000	West Tamar Flats - 65,000 m^3 Ti-Tree Bend West - 25,000 m^3
L.D. Marine	Mar 1995 to Sep 1995	East bank and channel between the synchrolift and the wheat berth	70,000 m^3	$290,000	Ti-Tree Bend West
*L.D. Marine	Sep 1996 to present	Home Reach	180,000 m^3	$756,000	Launceston Church Grammar School land at Stephensons Bend - 140,000 m^3 Ti-Tree Bend West - 40,000 m^3
TOTAL			***750,000 m^3***	***$4,031,000***	***> 392,000 m^3***

* Anticipated schedule for the current contract. As of July 1997, approximately 40,000 m^3 of material had been dredged from the yacht basin area.

Available sites for deposition of the dredge spoils in the vicinity of the Tamar Estuary are nearing capacity. At the completion of the current dredging contract, it is estimated that the remaining capacity of the prepared silt deposit areas at West Tamar Flats and Ti-Tree Bend West will be 30,000 m^3 each, for a total available capacity 60,000 m^3. This estimated available capacity will be confirmed following completion of the current dredging works. In an attempt to find an alternative for the deposition of dredge spoils, the recycling of silt mixed with sewage sludge for use as marketable fill has been proposed.

Environmental implications associated with dredging

Several environmental issues are associated with the implementation of dredging to control siltation. Dredging may cause the remobilisation of contaminants, which were previously relatively stable in the bottom sediments, resulting in higher bioavailability and potential impacts on the ecosystem. The disposal of dredge spoils adjacent to a water body also has significant environmental implications. Long term seepage of contaminated water may result, re-introducing pollutants to the waterway. Currently, the silt and debris dredged from Home Reach is placed in prepared silt deposit ponds adjacent to the estuary; inputs of contaminants from this source have not been quantified. Impacts on wetlands have also not been assessed.

Given the rapid filling of existing silt deposit areas adjacent to the Tamar, there is a need to identify viable alternative disposal sites. Land disposal of dredged materials requires careful consideration and is restricted according to guidelines developed by Environment Tasmania for the disposal of contaminated soils. In some cases, the disposal of dredged materials into deeper parts of the estuary could be considered, however, the flushing regime of the Tamar Estuary is such that dredged silt would need to be taken almost to the mouth of the estuary to prevent it from migrating back upstream.

Limited testing has been carried out on material dredged from the Tamar Estuary. In 1993, composite samples of dredged material and associated vegetation were collected from ten silt deposit ponds of varying ages (<1 to >18 years) near the Tamar. These samples were analysed for heavy metals (both total and DTPA-extractable), pH and nutrients (Department of Primary Industry and Fisheries, 1993). As indicated in Table 30, elevated concentrations of cadmium, chromium and zinc were found in a number of these samples, and cadmium was found to be readily leached. On the basis of guidelines established by Environment Tasmania for the off-site disposal of contaminated soils, it appears that 30 to 50% of the samples may be unsuitable for use as fill due to elevated concentrations of cadmium and zinc. Furthermore, chromium concentrations in all samples exceeded the guidelines.

Table 30 Metal concentrations in dredged silt from the Tamar Estuary

mg/kg	Total metal concentration range in Tamar dredge spoils	DTPA-extractable metal concentration range in Tamar dredge spoils	Environment Tasmania guidelines for disposal as fill
Cadmium	0.3-5.3	0.04-2.00	3
Nickel	24-39	0.34-1.94	60
Lead	4-63	ND-5.0	300
Chromium	53-79	ND	50
Iron		290-840	
Manganese		10-400	
Zinc	92-480	5-69	200
Copper	14-48	0.4-11.8	60

(Department of Primary Industry and Fisheries, 1993)

There was no clear difference in metal concentrations between older and more recently dredged material, suggesting that there is a continuing source of heavy metal contamination to the estuary. The main source of contaminants in the sediments of the upper Tamar Estuary is

generally assumed to be historical mining activities in the South Esk catchment (Section 4.5) which ceased in 1982, however, mining wastes continue to leach into the river system. Other historic sources - particularly for chromium - may also be present in the Launceston urban/industrial areas. Further monitoring of metals in sediments and dredged materials is recommended.

In addition to implications of dredging associated with contaminants in the environment, silt deposition on mudflats near the estuary may also affect wetland habitat. Much of the upper region of the Tamar Estuary is protected as a nature reserve and is a refuge for a diversity of wildlife. Deposition of silt on the mud flats and the trapping of silt by vegetation is likely to accelerate the natural process of silt accretion and may significantly alter wetland habitats.

7.3 Remediation and prevention measures

An investigative program is currently underway to address the siltation problem and manage maintenance dredging on a wider basis. This has involved identifying areas of erosion and accretion in the river bed, which areas should be dredged and how much should be removed. Regular monitoring of the river bed in the upper reaches of the Tamar has been carried out to measure silt accretion, shifting channels and scour during floods. A physical hydraulic model of the river system has also been recommended by TRIPC (Tamar River Improvement Projects Committee, 1995).

Trials using various prevention and remediation measures have been carried out, including the following.

- The establishment of silt traps at strategic points in the river bed to reduce the cost of pumping dredged silt to deposition sites.
- Trial methods of mud bank stabilisation by silt accretion, including artificial seaweed, drift fences and natural vegetation (both plantings and brushwood fencing). As early as the 1940s, the rice grass *Spartina anglica* was introduced in an effort to trap sediment and reduce siltation in the main channel.
- Reducing siltation by the operation of the Trevallyn Power Station in phase with the tides was also trialled for a short period. This was not viable, however, due to increases in the cost of operation.
- Silt fluidising techniques to scour and mobilise bottom sediments have been trialed to utilise natural currents to carry the silt downstream.

The siltation of the upper reaches of the Tamar Estuary is clearly an important issue, but it is a result of the natural morphology and hydrology of the estuary and catchment rather than pollution. However several important environmental and water quality issues are associated with management of siltation by dredging, silt deposition and silt trapping.