CHAPTER FOUR

SEDIMENTATION: THE BAY IS FILLING IN

"The one problem at Pak Phanang is that the outlet of the bay is too shallow, so big boats cannot enter."

King Rama V in a letter to the Crown Prince
July 9, 1905

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October 1, 2006

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LONGSHORE DRIFT: A SOURCE OF SEDIMENT

For nearly a century, the people of Pak Phanang have been concerned about the rate of sedimentation in the bay. The bay has become so shallow, we heard in recent interviews, that many fishing boats from the Gulf that used to come to Pak Phanang now go to the port at Songkhla. The shoaling has made fishing in the bay much less profitable according to many fishermen. The foremen of a boatyard remembered tales of the time that Pak Phanang was a busy port, bustling with traders from China, Malaysia and Singapore. But even then, according to the letter from King Rama V, shoaling was a problem and the Chinese merchants requested that dredging be done. Three oil storage terminals in Pak Phanang supply gasoline and oil for much of the Central South provinces. However the vessels that supply crude oil to the terminals can enter only at high tide, and are having more trouble doing so in recent years. Last year, a million liter oil tanker had to lighten off half their load before they could get over the shoals at the mouth of the bay and into the port. One of the terminals recently moved to Surat Thani, leaving Pak Phanang with only two.

In Chapter One, we briefly noted the geological history of the area, pointing out that for thousands of years, this has been an accretionary shoreline. Geologists suggest a chain of barrier islands lay offshore of the coast, creating a shadow zone to waves on the shoreline inside them. This created an along-shore difference in wave height in the lee of the islands, inducing convergent longshore currents from both ends of the shadow area. This led to the formation of land bridges to the mainland, and the eventual creation of Songkhla Lake and Pak Phanang Bay.

During the last ice age, sea level stood approximately 130 meters below its current level, thus the entire Gulf of Thailand was dry. Sea level rose to approximately 5-6 meters above the present level at the end of the ice age, and the shoreline was closer to the mountains. Sea level has remained approximately constant for the last 6000 years or so and the sandy shoreline has extended further from the original coast. In recent geological history, major changes have happened on the eastern shoreline of southern Thailand that show clearly the importance of longshore transport of sediment in shaping the morphology of Pak Phanang Bay (Figure 4.1). A map of the Kingdom of Siam and the Cochin Sea, published in 1828, showed a large island, Tantalem, lying offshore of the area between Songkhla and Nakhon Si Thammarat, creating an inland sea. By 1893, the mainland had grown out to the island, forming what is now known as Songkhla Lake. The East Asia Road Map published in 1960, and landsat photos starting in 1971, show Songkhla Lake to be considerably smaller than in 1890. The cape labelled *"Lem Kolam Puk"* in 1890 now firmly joined to the land, and the Pak Phanang river extending northward along the coast. The maps probably are not completely accurate, but the impression they give, of an outward growing shoreline whose dynamics are dominated by longshore drift certainly is.

Longshore drift along eastern shoreline.

Figure 4.1.
Shoreline development in the Songkhla-Nakhon Si Thammarat area.

At present, Pak Phanang bay is approximately 14 km long and has an average width of 7.7 km, covering an area of nearly 126 km sq. Three rivers empty into the bay: Pak Phanang River, Khlong Bang Chak and Khlong Pak Nakhon, but only the Pak Phanang River is a significant source of freshwater. It also is the major source of sediment for the inner bay. (Figure 4.2)

The most extensive work so far on the currents and sedimentation in Pak Phanang Bay was a feasability study for dredging a navigation channel through the bay to the river. The data in this report form the basis for most of the conclusions to follow.

Figure 4.2.
Map of Pak Phanang Bay showing the mud flats, the channel and the rivers entering the Bay. Depth are in meters.

PAK PHANANG RIVER: A SOURCE OF SEDIMENT

The Pak Phanang River is one of the largest rivers in the south, with a length of 110 km and a catchment area of somewhat more than 1,000 km sq. The first 50 km of the river are broad and flat with a slope of only 0.0002 or less. In the first 10 kilometers upstream from the bay, the river is 250 m or more wide and 5 to 8 m deep. In the upper 50 km, the river narrows, and has a slope of about 0.001, so runs faster than in the lower reaches.

There are two tidal cycles per day, but one has a much larger range than the other, giving the impression of a single tide (Figure 4.3). The maximum tidal range at the head of the bay and in the lower part of the river is about one meter. Early interviews indicated that the tidal influence is felt as 12-20 km upstream of the river mouth. However, on a trip downriver in August 1991, tidal changes in water level occurred at Cha Uat, 80 km along the river course from the mouth and the first traces of saline water at Ban Tha Chit Chan, about 45 km from the river mouth. Tidal currents vary according to locality and depth. In the middle of the channel at the mouth of the Pak Phanang river, as well as in the deeper parts of the bay, the tidal velocity reaches a maximum of 0.7 m/sec.

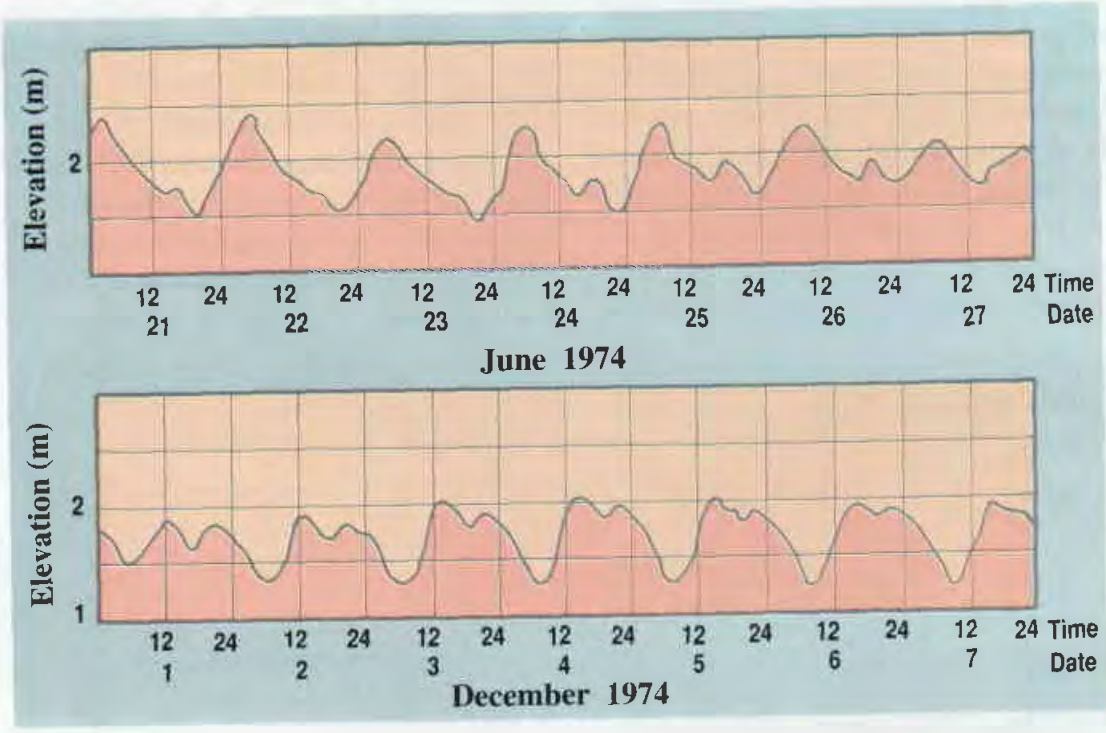

Figure 4.3.
Examples of tidal change near the mouth of the Pak Phanang River.

Nakhon Si Thammarat Fishing Port at the inner part of Pak Phanang Bay.

From March to September, the river flows slowly, but the discharge increases considerably during the wet months of November to January (Figure 4.4). Riverine sediment transport into the bay has been estimated to be about 1.2 million tons per year, with about 70% arriving during the rainy season, between November and January. The fishing port feasability study done by Japan International Cooperation Agency (JICA), using data from the 1977 A.I.T. report, estimated that over 640,000 tons of sediment are deposited annually in the first four km of the bay just beyond the river mouth. Another 355,000 tons are deposited between there and the opening of the bay at the Gulf of Thailand. Southern portions of a 30 km long navigation channel have been dredged sporadically to a depth of approximately 4 m below mean low water, however the dredging equipment could not handle the sandier sediments at the gulf end of the bay. Local residents indicate that the channel never actually has been dredged all the way out from the harbor.

Bottom profiles along the channel in two years, 1985 and 1989, are shown in Figure 4.5.

The nature and distribution of sediments in the bay are a result of the dynamics of settling of suspended matter. Silt and clay from the watershed are deposited near the interface between sea and river waters while coarser sediments are found near the mouth of the bay. Sandy clay is an important element in shoaling along the eastern shoreline, while field surveys reveal that there is practically no sand along the western shoreline of the bay, where the sediments are primarily clays and fine silt.

Two areas in the bay have undergone extensive shoaling in the past 30 years (Figure 4.6). At the west side of the mouth of the river, a delta has formed, increasing the length of the river. The area of the delta has nearly doubled since 1961. The mudflat and mangrove area along the eastern shore of the bay has increased substantially in the same period.

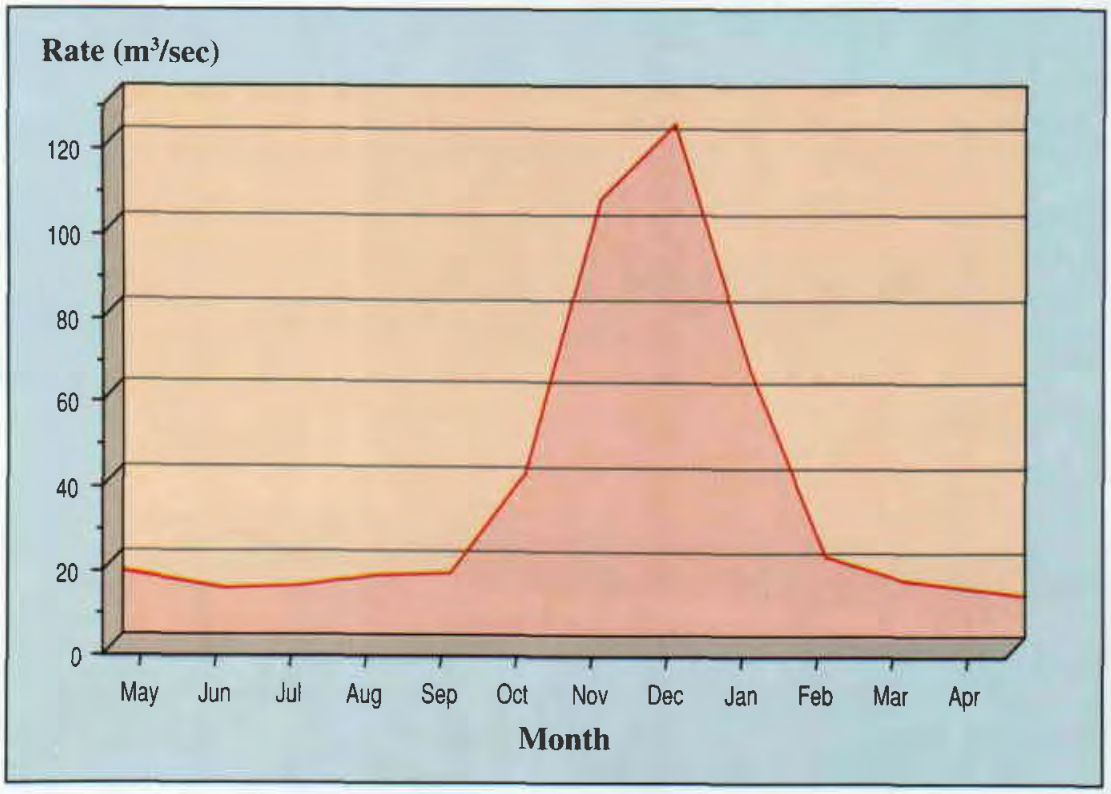

Figure 4.4.
Monthly water discharge of the Pak Phanang River.

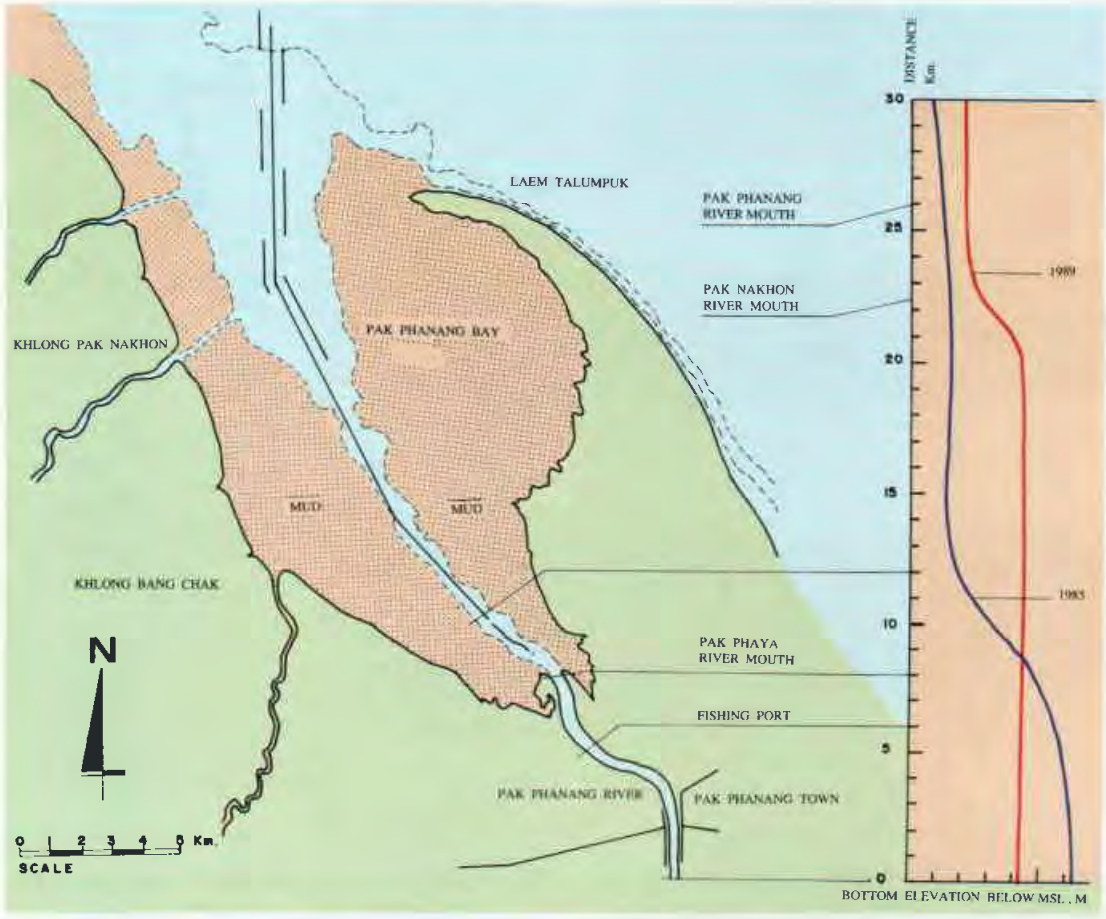

Figure 4.5.
Location of the dredged channel and bottom profiles of the channel in 1985 and 1989, Pak Phanang Bay.

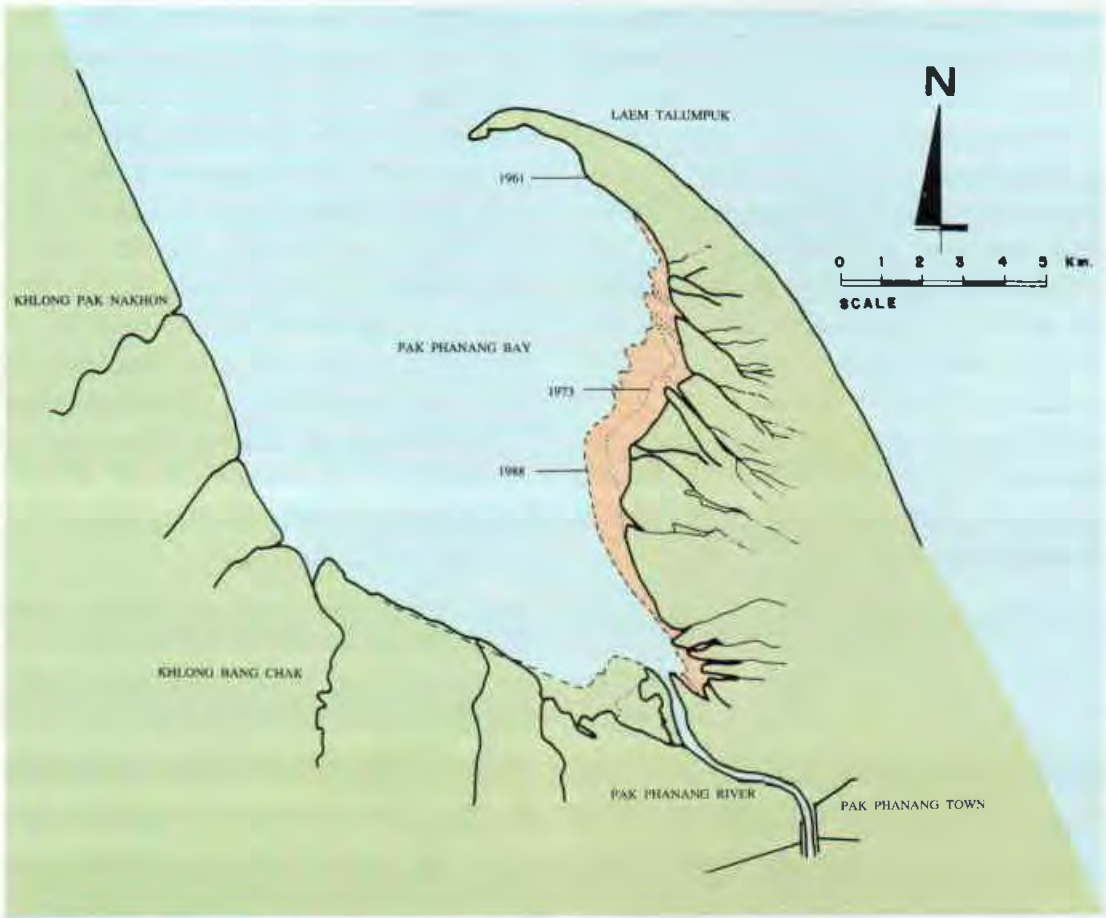

Figure 4.6.
Changes in the borders the mouth of the Pak Phanang River and the eastern shore of the Bay from 1961 to 1988.

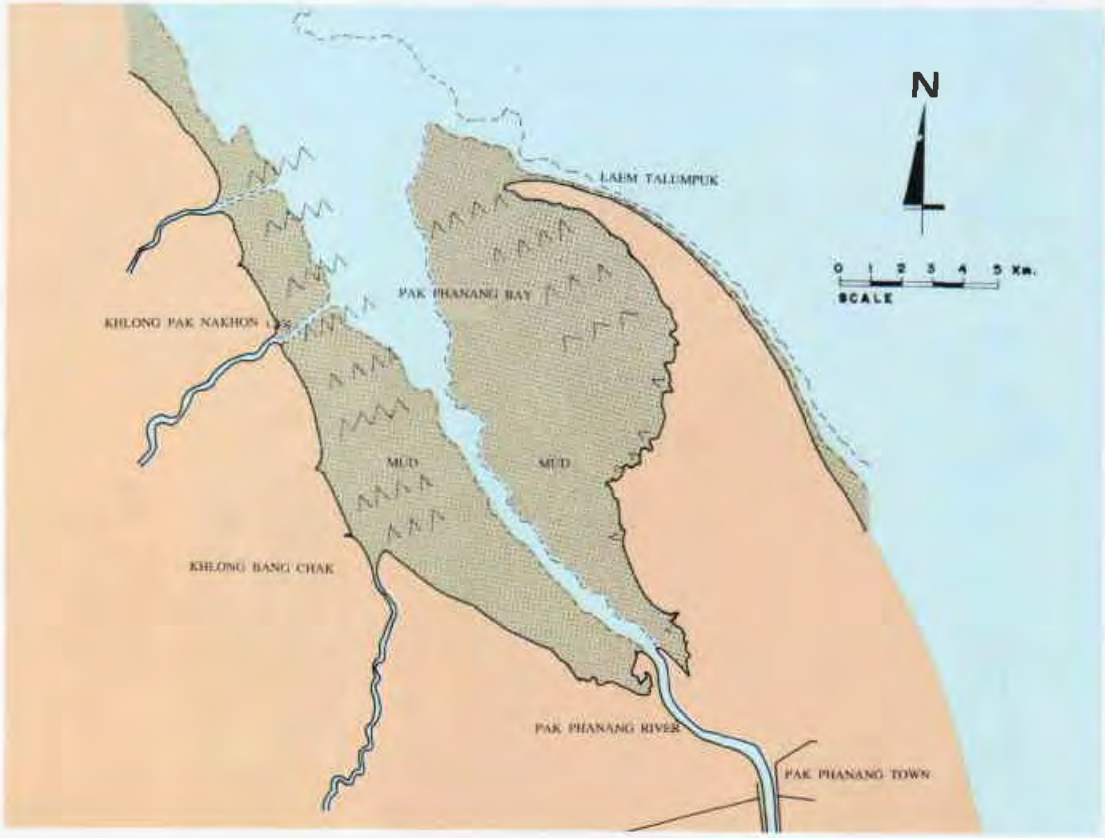

Figure 4.7. *Locations of lift net (indicated by ^) on intertidal mudflat areas of Pak Phanang Bay.*

Fishermen and navigators are very sure that the bay has become more shallow within recent memory. Some types of fishing gear have had to be abandoned, and others catch less because the depth has decreased. The natural process of accumulation of sediments in the bay guarantees that the progressive shoaling will continue, and that mangroves will colonize the intertidal areas, and encroach on the bay. Eventually the entire bay will fill in except for the present channel, which will become the river. The rate at which the shoaling will take place is not known, nor is the effect of present practices such as dredging and use of fixed fishing gear.

The pattern of circulation is a result of the combined influences of tidal currents, river discharge and the geometry of the bay. The dredging of the channel certainly influences the geometry of the bay, and thus is likely to influence circulation patterns. Permanently placed lift nets with bamboo fish trap are found in ranks 1 to 2 km long and 500 m apart on both sides of the channel (Figure 4.7). They may have altered the pattern or speed of currents in the bay, and influenced both the rate and location of sedimentation. Further studies are needed to determine if and how both the dredging and the fishing activities have influenced the process of sedimentation in the bay.

Lift net, a stationary fishing gear.