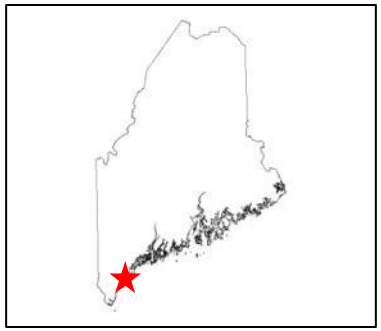
Geologic Site of the Month

October, 2001

Laudholm and Drakes Island Beaches: Before and After Beach Nourishment



43° 19‘ 14.22“ N, 70° 33‘ 37.29“ W

Text by
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Introduction

In the fall of 2000, sand from Wells Harbor (Figure 1; Figure 2) was dredged and pumped onto adjacent beaches. Lower Landing Road crosses the salt marsh to development on dredged sand placed on the marsh in the 1960s. Between the salt marsh of the Rachel Carson National Wildlife Refuge and Wells Beach are houses built on sand dunes of the barrier spit.

Figure 1. Air photo of Wells Harbor in the Webhannet River estuary, the tidal inlet with two stone jetties, and Wells and Drakes Island Beaches. Photo taken near low tide on July 16, 1995.

Dredging and Nourishment

Placement of the dredged sediment on the beach was a low-cost disposal option for the US Army Corps of Engineers during maintenance of a federal channel and anchorage.

Figure 2. Wells Harbor was closed in the fall of 2000 for dredging the tidal inlet channel and part of the sandbars of the flood-tide delta. Part of the former federal anchorage was not dredged and placed in a conservation easement for preservation of some of the sandy intertidal flood-tide delta and adjacent salt marsh and channels.

Dredging and Nourishment

In less than three months, about 180,000 cubic yards of sediment was pumped through pipelines onto Wells and Drakes Island Beaches from a suction dredge with a rotating cutter head (Figure 3).

Figure 3. The suction dredge in Wells Harbor. The rotating cutter head is lifted out of water. Metal arms extend to either side of the dredge and have anchors that are used to position and move the cutter head on the bottom. Water and sediment are pumped through a floating pipeline to shore and then across the dunes to the beach.

Dredging and Nourishment

At the end of a pipe, sand and water slurry was released on the beaches (Figure 4; Figure 5) at various points. As much as 6,000 to 8,000 cubic yards of sand were pumped onto the beach in a day. Dewatered sand was shaped with bulldozers into a higher beach profile with more sand at the high-tide line and in front of seawalls.

Figure 4. On the beach, the pipeline releases a slurry of water and sediment. Most of the sand was placed on Wells Beach and Drakes Island Beach in the form of a berm near seawalls or the frontal dune at the elevation just above the mean high-tide line.

Dredging and Nourishment

This nourishment occurred on the higher elevations of the beach profile in the vicinity of the berm, or area of summer sand accumulation. The elevation of the "fill" was marked on the Casino Point seawall with a red paint line. A visit to this location will show the paint line in relation to the current beach elevation. Since Casino Point is a headland, sand was dispersed away from it by wave action toward the beaches to the north and south.

Figure 5. Nourishment built a berm out from Casino Point in Wells. After the slurry was dewatered, bulldozers formed an artificial terrace.

Beach Profiles

In order to follow the movement of sand on Drakes Island Beach and state-owned Laudholm Beach, the Maine Geological Survey measured beach profiles before the nourishment and three months later. The profile lines used were the same as those used by teams of volunteers from the region who measure the beach monthly (volunteer profiling). Here we summarize the changes to the beach profiles on Drakes Island Beach as a result of nourishment and on Laudholm Beach as a result of natural changes without nourishment (Figure 6). The locations of six beach profile lines are shown. Drakes Island #1 is closest to the north jetty. Drakes Is. #3 and 4 received a large volume of sand in the process of nourishment from dredging Wells Harbor (shown in the lower left corner).

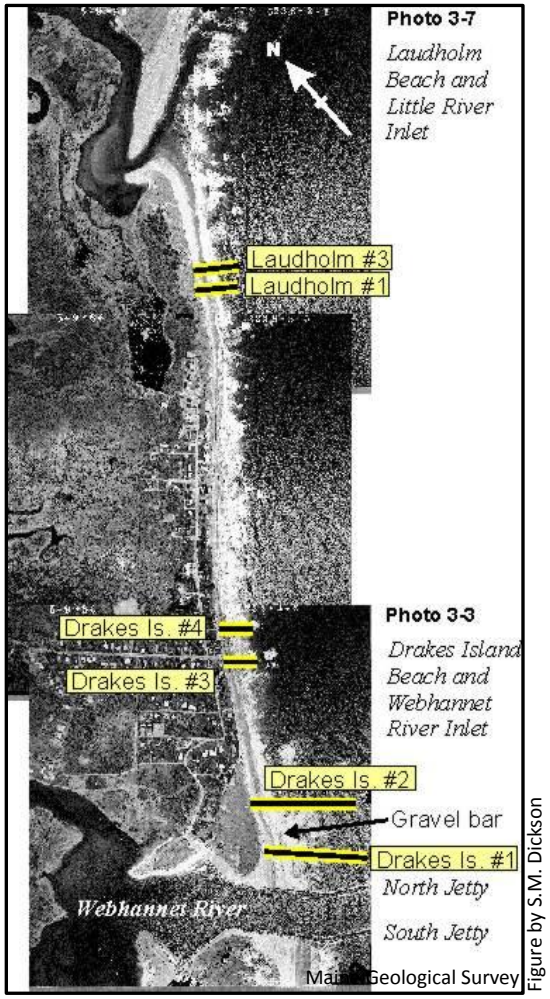

Figure 6. Air photo mosaic of Drakes Island and Laudholm Beaches.

Beach Profiles

Six beach profiles were measured on 9/20/00, a few days before Wells Harbor dredging began and three months later on 12/19/00, soon after the dredging and beach nourishment were completed. Sand was placed primarily on the beach in the vicinity of Drakes Is. #3 and #4 profiles. No sand was placed directly on the Laudhom profile lines.

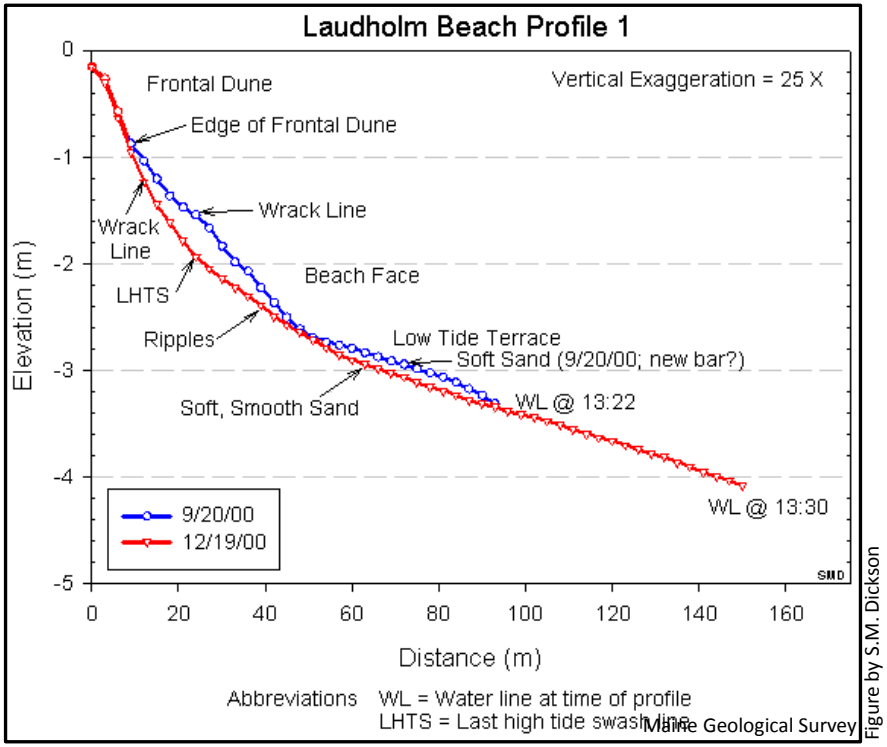

Figure 7. Laudholm Beach Profile 1 shows a loss of sand across the full profile, including the beach face and low tide terrace, from September to December 2000. Note the horizontal and vertical scales are different; this results in a large vertical exaggeration in order to show the differences in the two lines.

Beach Profiles

Laudholm Beach Profiles #1 (Figure 7) and #3 (Figure 8) showed very little change. A late-summer beach face eroded 20 to 40 cm and the profiles became more convex. There was no immediate gain of sand on the Laudholm profiles as a result of nourishment on Drakes Island.

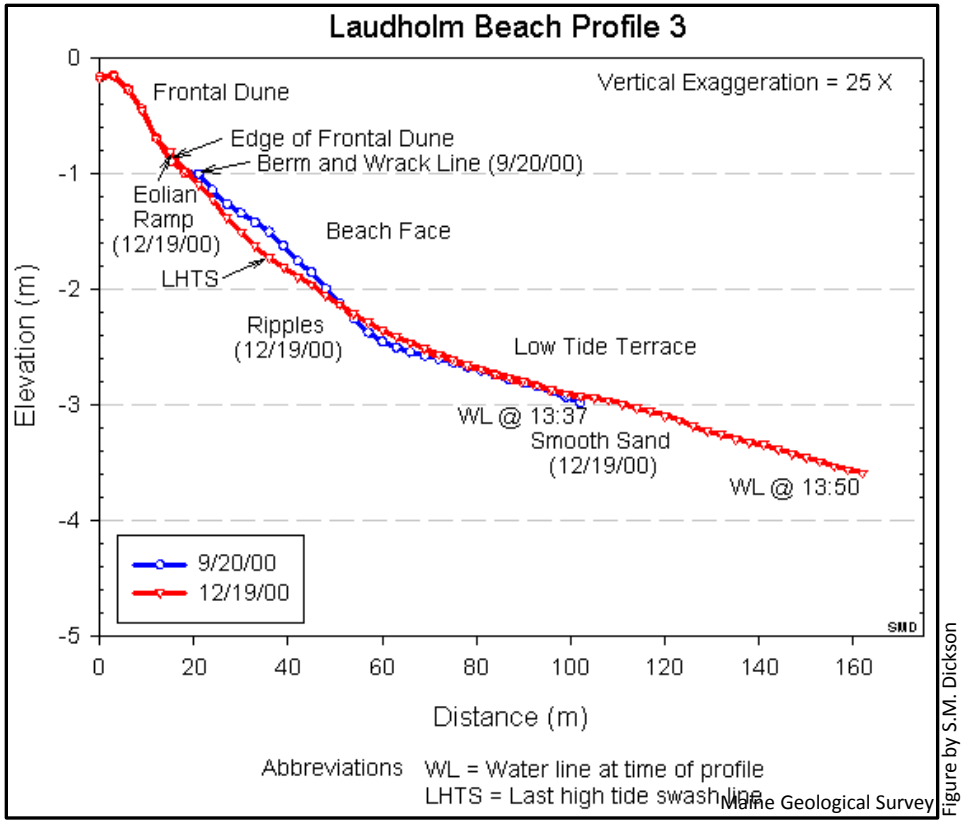

Figure 8. Laudholm Beach Profile 3 shows a loss of sand on the beach face and little change on the low tide terrace from September to December 2000.

Beach Profiles

All of the Drakes Island beach profiles (Figures 9, 10, 11, 12) showed a gain of sand over the three-month period. With the exception of a berm that eroded off Drakes Is. #2, the upper profiles had a smooth slope up to the frontal dune or a seawall. This slope almost certainly formed by wave action two days earlier during the second major fall storm. The artificial berm, built with sand from beach nourishment, had been partially reshaped by waves.

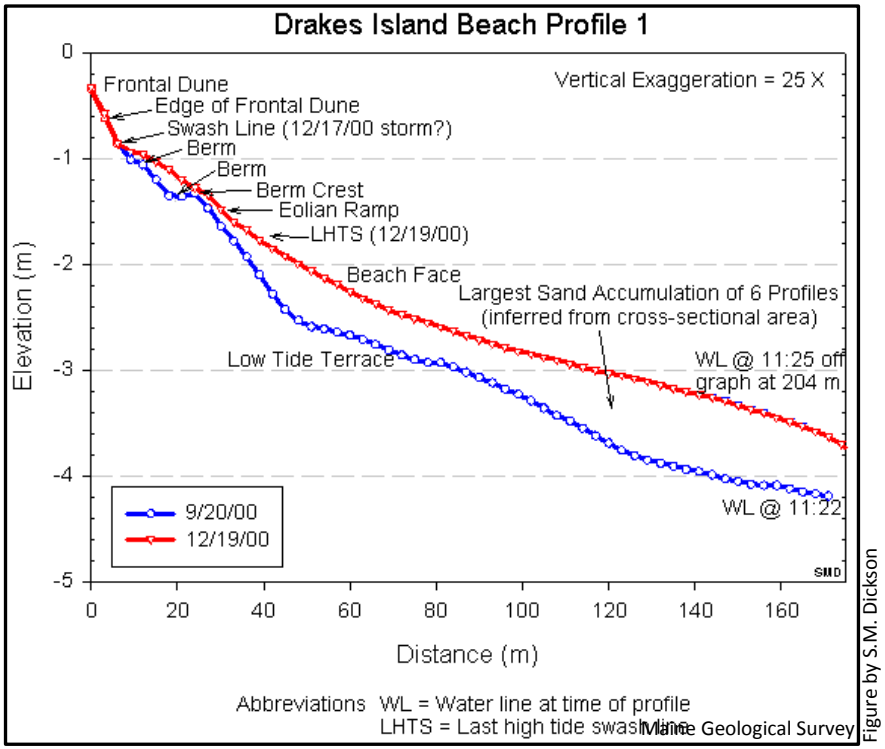

Figure 9. Drakes Island Beach Profile 1 shows a large net gain of sand throughout the berm, beach face, and particularly on the low tide terrace from September to December 2000.

Beach Profiles

Drakes Is. #2 showed about 80 cm of vertical sand accumulation near the low-tide line. This buildup may be the result of impoundment adjacent to a gravel bar between profile lines #1 and #2. Drakes Is. #1 gained 40 to 75 cm on the beach face, and had the most volume gain of any of the six profiles measured. This accumulation occurred next to the north jetty of the Webhannet River.

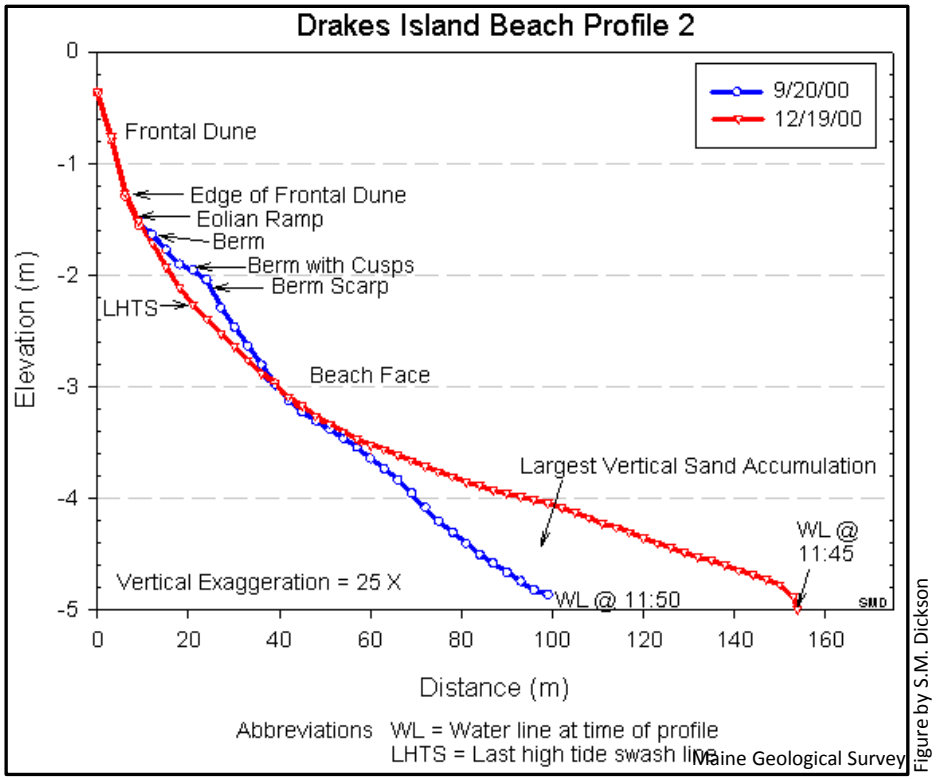

Figure 10. Drakes Island Beach Profile 2 shows a small sand loss from the berm and a considerable vertical buildup on the low tide terrace below the beach face from September to December 2000.

Beach Profiles

The upper profile was about 20 cm (8 in) higher than the September 20, 2000 pre-nourishment profile. Wave-reworked beach nourishment was sloped up 70 cm (28 in) against the seawall at the end of Drakes Island Road. Since September, there was no significant buildup of sand on the lower profile out to the low-tide line.

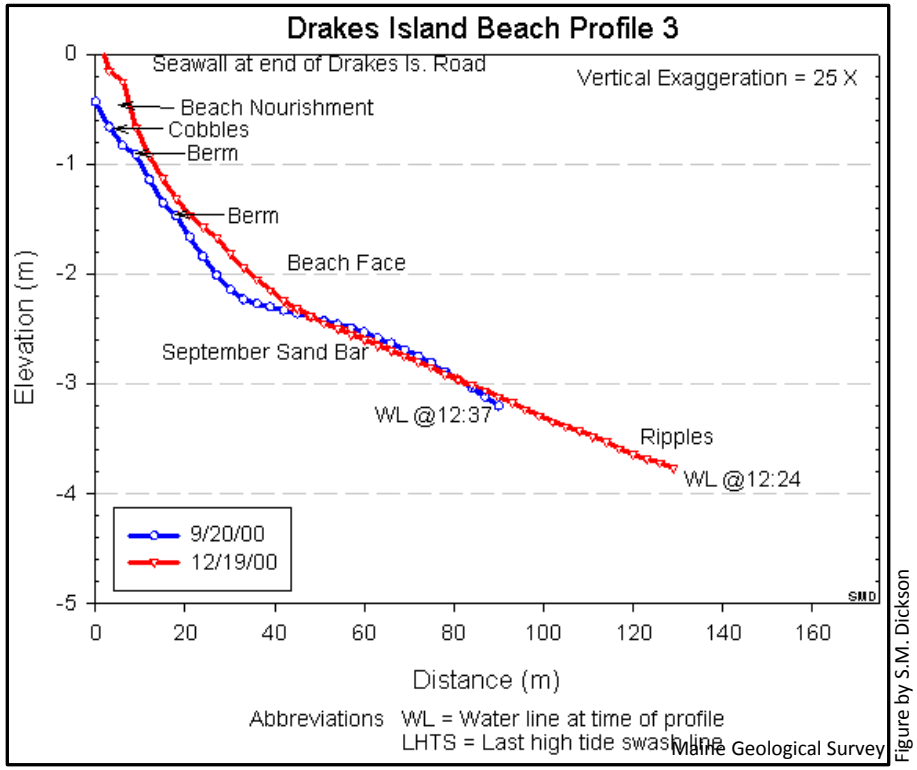

Figure 11. Drakes Island Beach Profile 3 shows nourishment built the profile up along the seawall, berm, and beach face from September to December 2000. The low tide terrace remained about the same over this period.

Beach Profiles

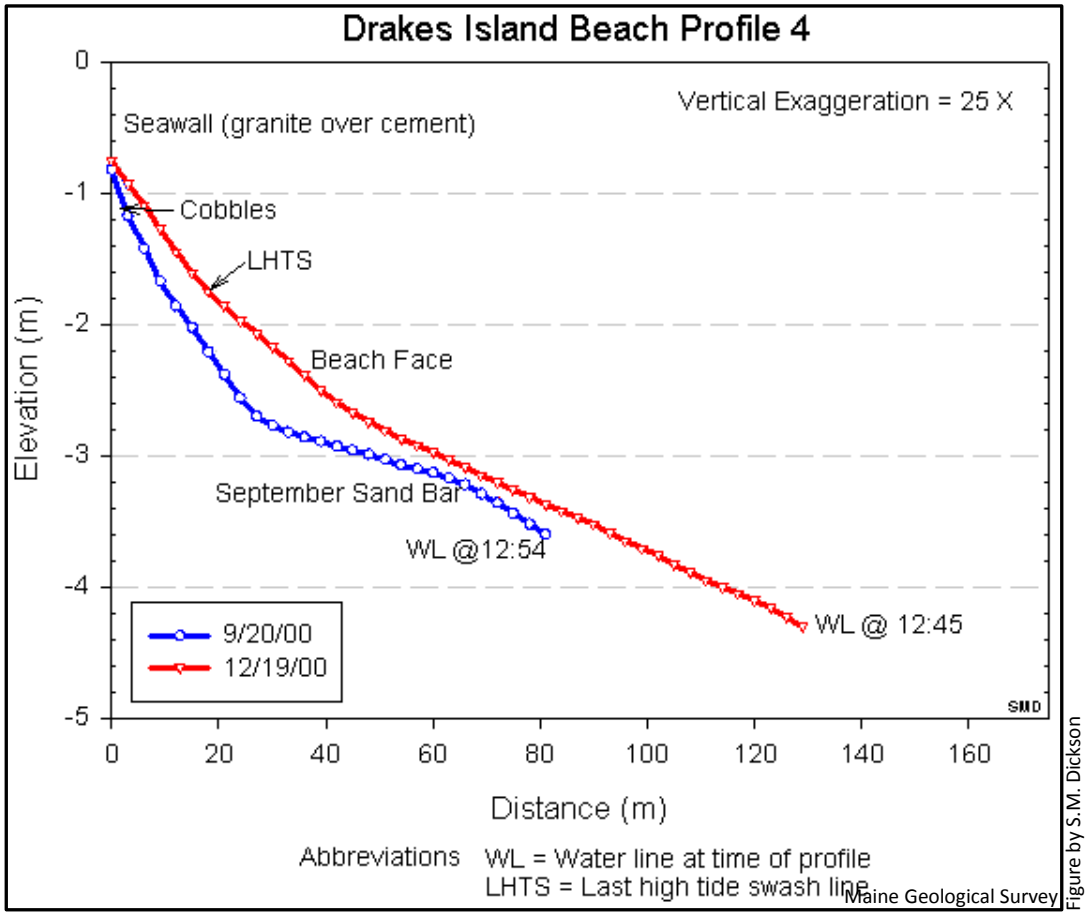

Figure 12. Drakes Island Beach Profile 4 shows an small accumulation next to the seawall and a higher profile across the beach face from September to December 2000.

Conclusions

The profiles at Laudholm Beach experienced a small loss of sand from the upper portions of the profile in the vicinity of the high-tide line (Figures 7 and 8). This change was most likely due to wave action in recent fall storms. Laudholm did not see any significant buildup of sand due to longshore drift (shore-parallel sand transport) from the beach nourishment area on Drakes Island.

On Drakes Island, beach profiles were altered by the initial placement of sand near the seawalls and frontal dune. In general, the profiles showed some of that sand remained in place after the first two fall storms. The artifical berm (not shown on graphs) however, had been reshaped into a smoother slope. A considerable buildup occurred on the lower portions of Drakes Island profiles #1 and #2.

Conclusions

This new accumulation is from the redistribution of the nourishment alongshore to the south by the process of longshore drift and down the profile from wave action and the influence of gravity (Figure 13). This pattern of sand transport and accumulation has occurred since the 1960's, soon after the jetties were built (Kelley and Anderson, 2000).

Photos by S. M. Dickson

Figure 13. (Left) This profile line (Drakes Is. #1) is the nearest of six to the north jetty of the Webhannet River. The December 19, 2000 beach face has built up about 40 to 75 cm (16 to 30 in) vertically from the berm to the low-tide line. (Right) Drakes Is. #3. A December 19, 2000 picture shows mixed sand and gravel on the upper beach profile from dredged harbor sediment.

References and Additional Information

Maine Geological Survey Marine Geology Index Page

State of Maine Beach Profiling Project

University of Maine Marine Geology Working Group

U.S. Army Corps of Engineers, New England District

Rachel Carson National Wildlife Refuge

Town of Wells, Maine

Kelley, Joseph T., and Anderson, Walter A., 2000, The Maine Shore and the Army Corps: A Tale of Two Harbors, Wells and Saco, Maine: Maine Policy Review, v. 9, no. 2, p. 20-34.