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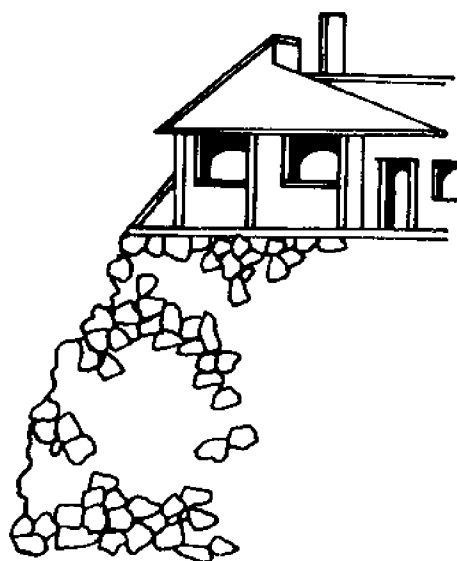
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The Causes of  
**EROSION TO  
SILETZ SPIT,  
Oregon**

Paul D. Komar  
C. Cary Rea



OREGON STATE UNIVERSITY  
SEA GRANT COLLEGE PROGRAM  
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## acknowledgment



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## related publications

DEVELOPMENT AND EROSION HISTORY OF BAYOCEAN SPIT, TILLAMOOK, OREGON, by Thomas A. Terich and Paul D. Komar. Publication no. T-73-003. 144 pp.

Chronicles the history of Bayocean Spit, where construction began on a large recreational resort in the early 1900's. Although a promising venture at first, the resort soon fell victim to financial problems caused by delays in completing a rail link to the spit. Severe erosion, thought to have been caused by construction and subsequently lengthening of a north jetty to the Tillamook Bay channel, eventually forced abandonment of the deteriorated resort.

SHORELINE CHANGES DUE TO JETTY CONSTRUCTION OF THE OREGON COAST, by J.R. Lizarraga-Arciniega and Paul D. Komar. Publication no. T-75-004. 85 pp.

Examines patterns of beach erosion and accretion due to jetty construction along the Oregon coast. Nine jetty systems are included; only the Columbia River system is not considered. Describes a computer model which simulates the shoreline changes that occurred following construction of the jetties on the Siuslaw River mouth. The shoreline advances of the model agreed closely with the actual shoreline changes found in surveys following jetty construction.

OREGON'S ESTUARIES: DESCRIPTIONS AND INFORMATION SOURCES, by K.L. Percy, C. Sutterlin, D.A. Bella and P.C. Klingeman. Publication no. H-74-001. (Price: \$2.50) 294 pp.

Summarizes much of the known information about Oregon's 13 major estuaries, excluding only the Columbia River estuary. Numerous citations of literature and agencies from which further information can be obtained make this an excellent "starting point" for assembling physical, chemical and biological data about Oregon's estuaries.

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## introduction

Severe erosion occurred on Siletz Spit on the central Oregon coast in the winter of 1972-73 (Fig. 1). One partially constructed house was lost and others were saved only by the immediate placement of riprap, large rocks installed at the base of the property to prevent wave erosion. This episode of erosion received widespread publicity in the news media. For a time it was feared that the spit might breach, much like Bayocean Spit had in 1952 on the northern Oregon coast.

The erosion to Bayocean Spit resulted from the construction of a jetty at the entrance to Tillamook Bay. No jetties are present at the Siletz Bay inlet. Instead, the erosion is associated with rip currents, strong narrow currents that flow across the surf zone to out beyond the breakers. Rip currents erode embayments on the beach, at time cutting back into the dunes on which the houses were built.

Because conditions similar to Siletz Spit occur elsewhere on the Oregon coast, such episodes of erosion could be repeated. Documenting the erosion to Siletz Spit and explaining its causes may help prevent this.

### RECENT EROSION

At the time of erosion to Siletz Spit in 1972-73 the existing houses had been present for less than ten years and there had been no prior development. Little was known concerning the spit's erosional history. In 1970-71 erosion did occur along a 670 meter (2200 feet) section of foredunes at the south end of the spit and a small stretch at the northern part of the developed section. Riprap placement prevented appreciable foredune losses and no houses were seriously threatened. The maximum dune bluff recession, 15 meters (50 feet), occurred in a park area left unprotected.

The winter of 1971-72 was mild and no strong storms developed. Only minor erosion occurred, except in the park area where the foredune retreated another 20 meters (65 feet).

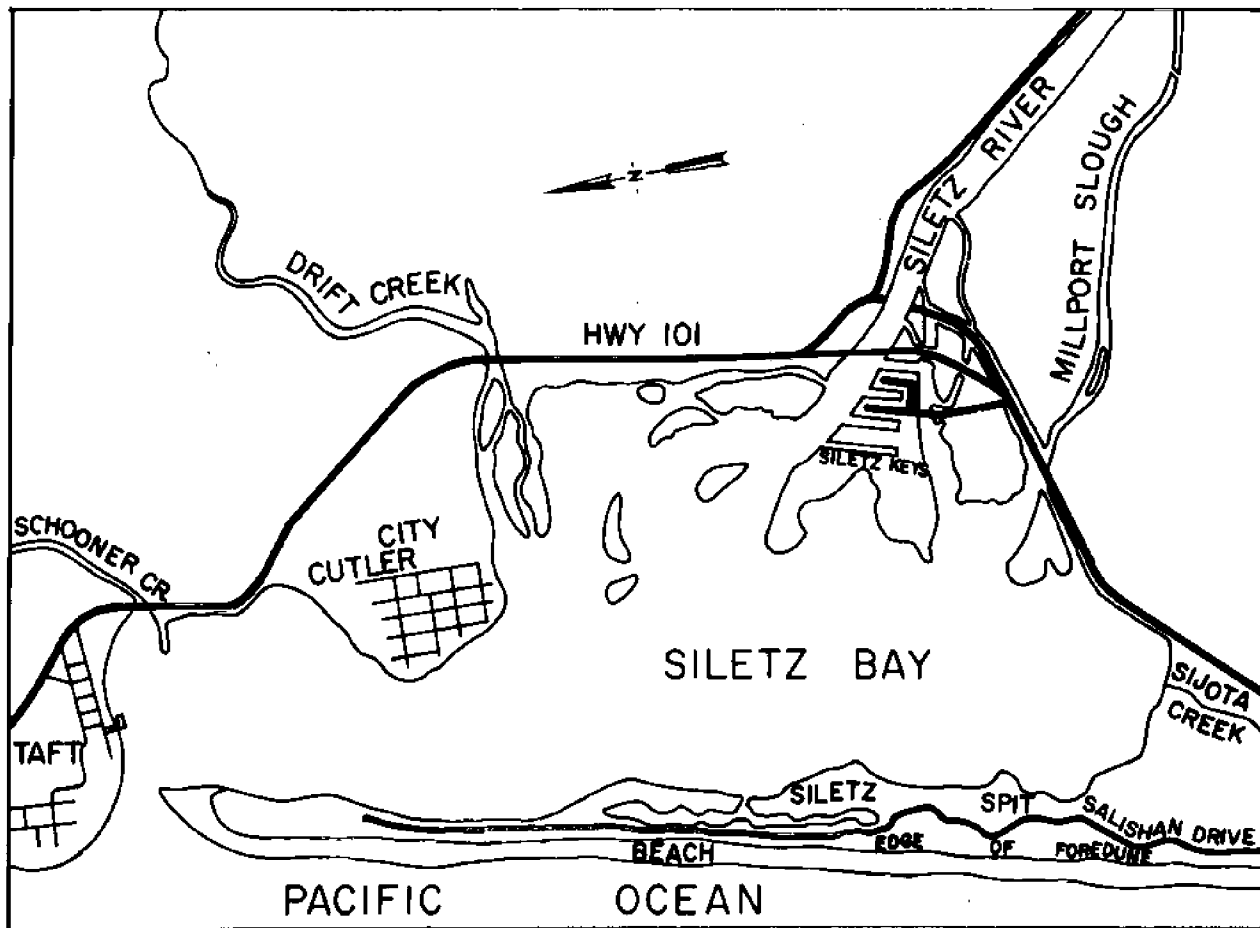


Fig. 1. Site location for the Siltz Spit and Bay area.

The severest episode of erosion occurred during the winter of 1972-73. One partially built home was destroyed (Fig. 2) and others had to be protected by riprap on three sides (Figs. 3 and 4). The worst erosion took place along a 650 meter (2100 feet) stretch of the central spit, opposite the artificial lagoons cut into the bay-side of the spit. Fig. 5 diagrams the erosion to the base of the foredunes, the maximum recession amounting to 30 meters (199 feet) in a three-week period. Individual homeowners placed riprap in front of their properties, but vacant lots left unprotected continued to erode. This flank erosion in the empty lots made it necessary for the houses to be protected on their sides as well. The group of three houses ended on a promontory supported by riprap (Figs. 3, 4 and 5).

Due to a disagreement as to who should pay for the placement of the riprap, erosion to the empty lots was allowed to proceed until it neared the road. Riprap was finally

installed at this time.

Lots on the spit are leased on a long term basis from the developer; they are not purchased outright. The disagreement regarding payment for the riprap was between the developer who still owned the lots and the individual leaseholders. This is presently being settled in court.

#### LONG TERM EROSION

Erosion of the dunes on the spit exposed numerous drift logs, many of which had been sawed (Fig. 6). This indicates an association with logging in the Oregon coast area. The main influx of settlers and logging started about 1895. Sawed logs within the spit indicate that the portion of Siletz Spit on which the houses had been built must have suffered previous erosion, sometime after 1895. After that early erosion the dunes must have built back out and become re-established.

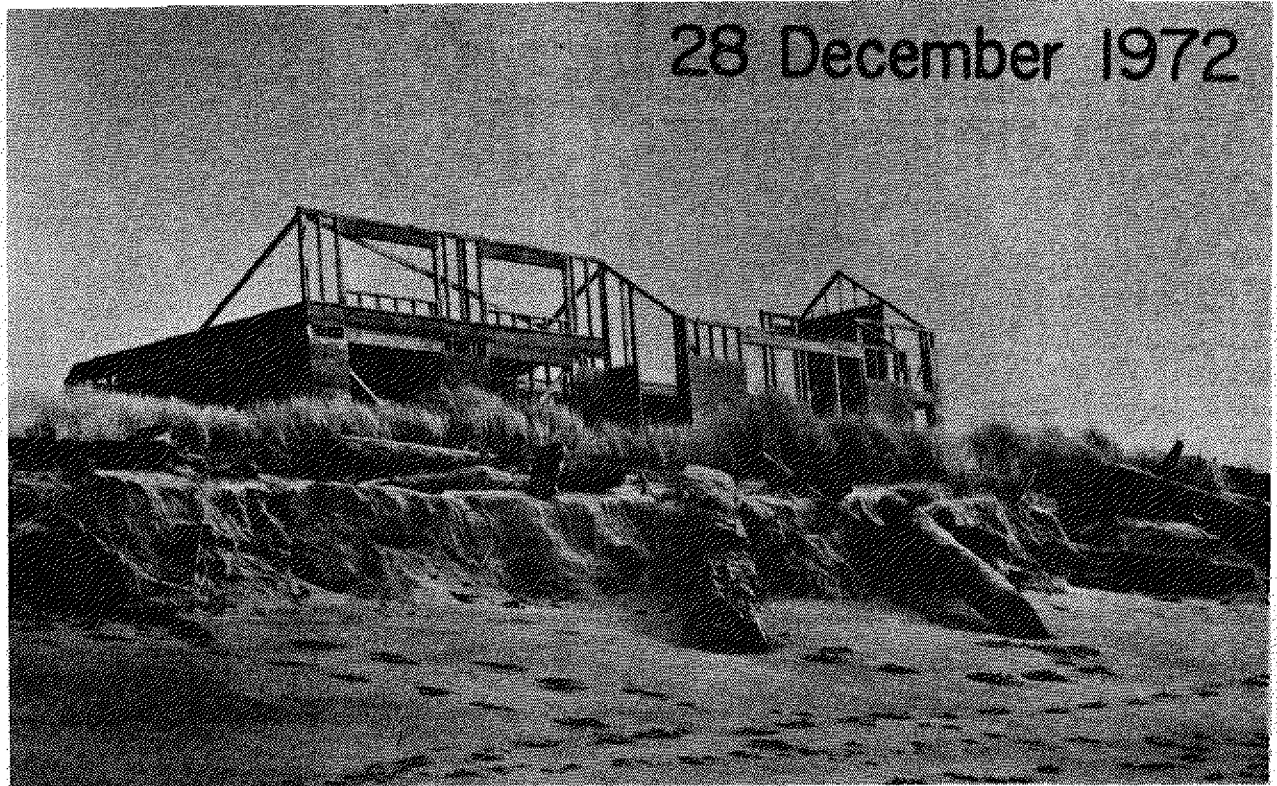
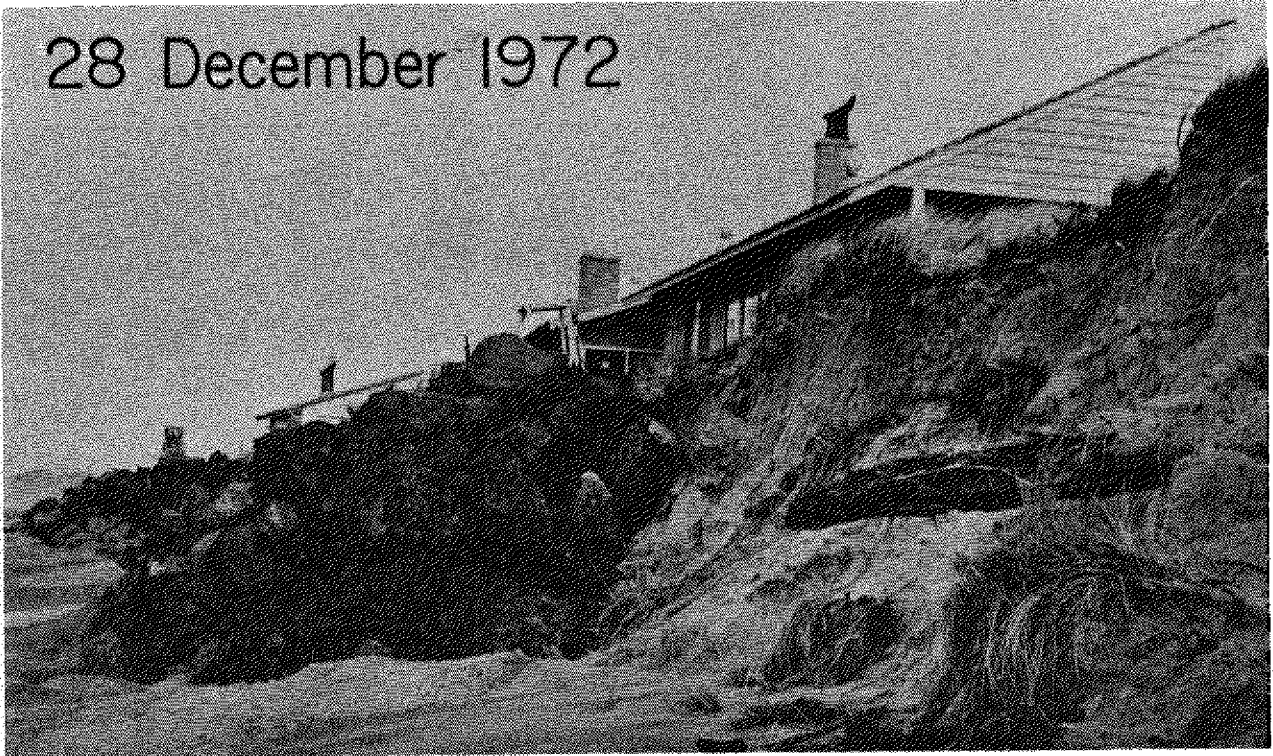


Fig. 2. Erosion and destruction of the house under construction on lot 226 of Siletz spit.

28 December 1972



19 January 1973

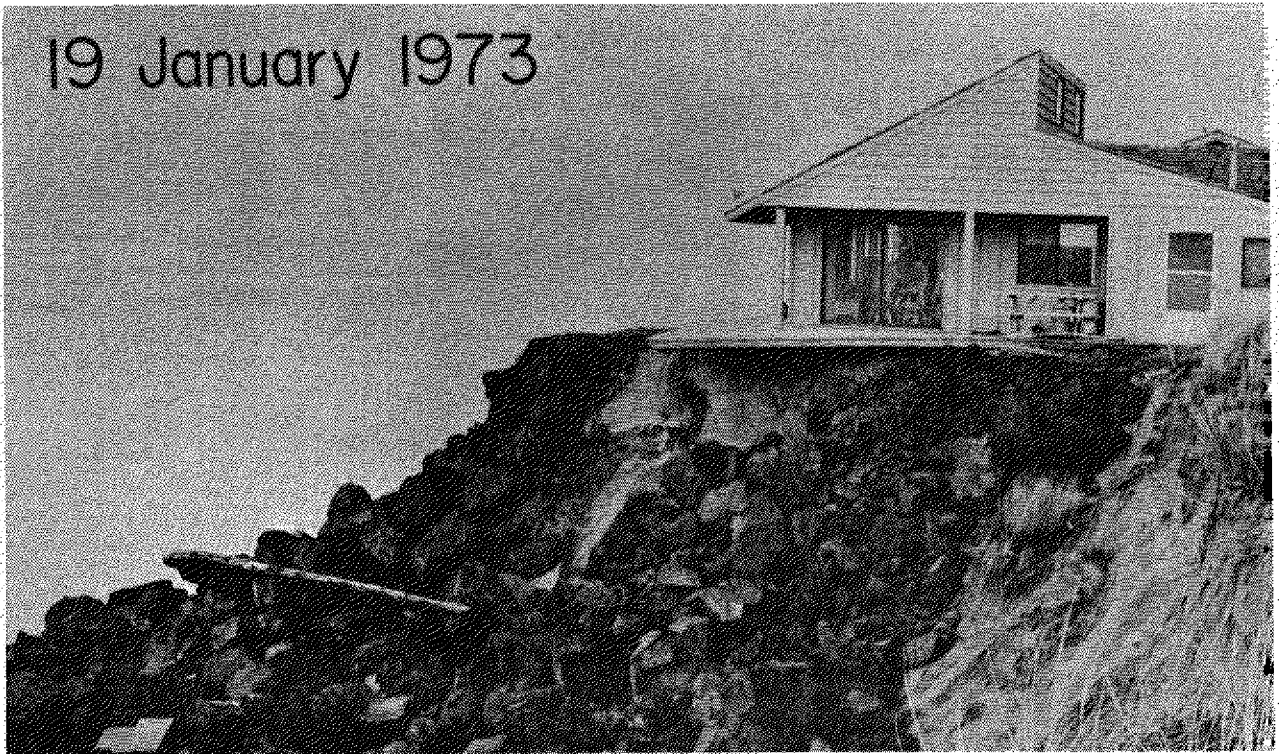


Fig. 3. Erosion around the house on lot 229-A. In the upper photo rapid erosion required the placement of riprap in front of the home. But no riprap was installed in the adjacent vacant lot so erosion continued along the side as seen in the lower photo.



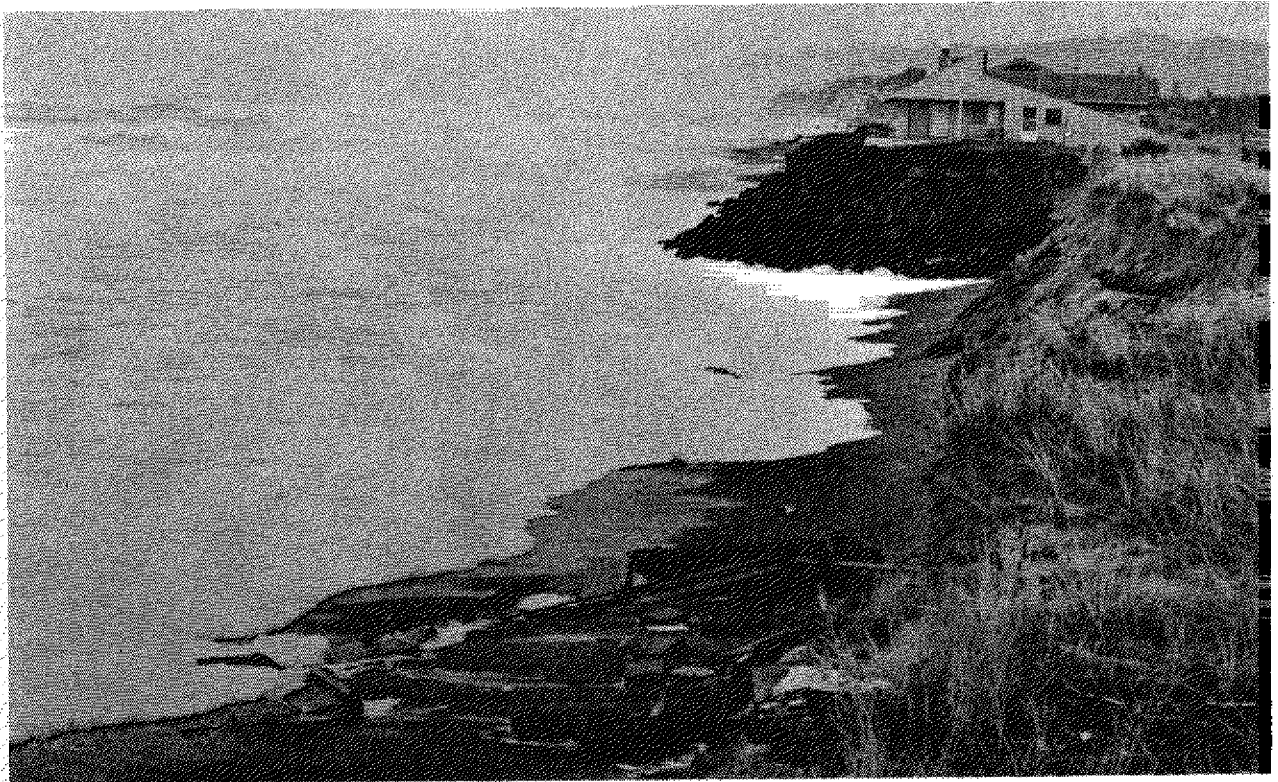


Fig. 4. View showing both houses of Figs. 2 and 3.

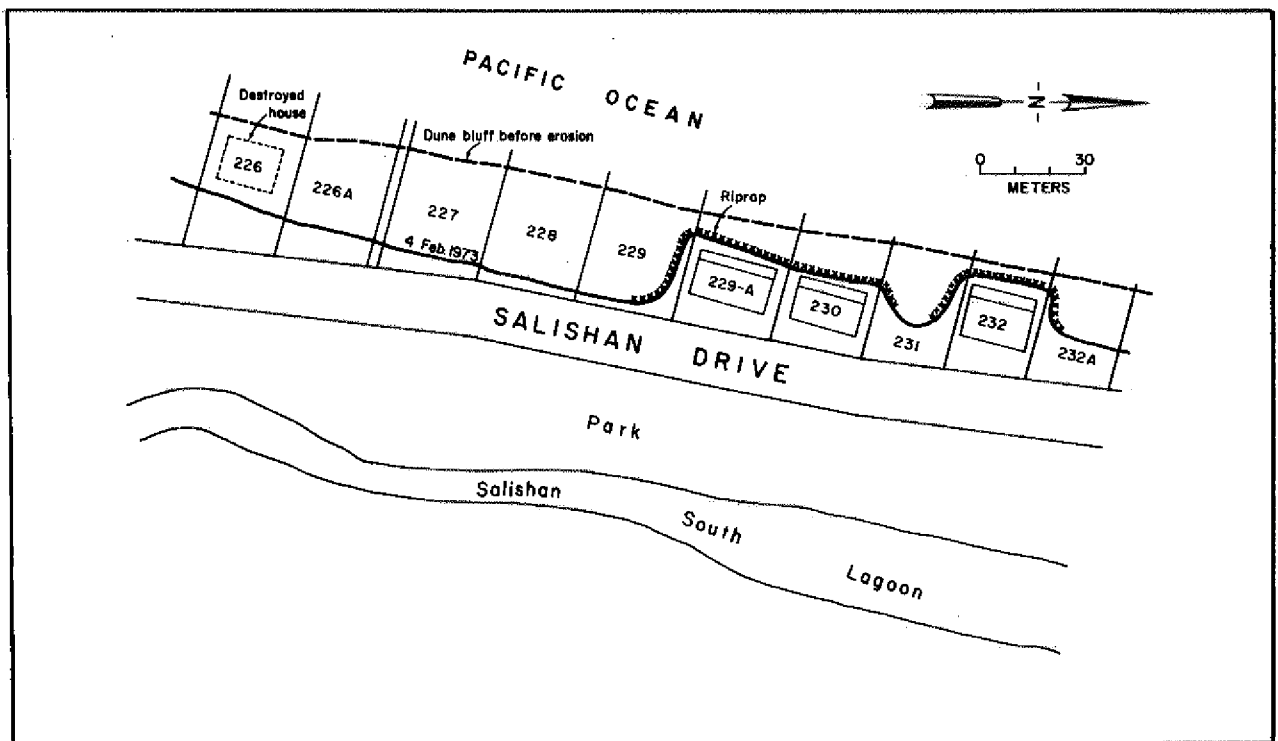


Fig. 5. Successive surveys showing the retreat of the edge of the dune bluff. Riprap around lots 229-A through 232 prevented their erosion, but the erosion of the adjacent lots left them on a promontory extending out onto the beach.

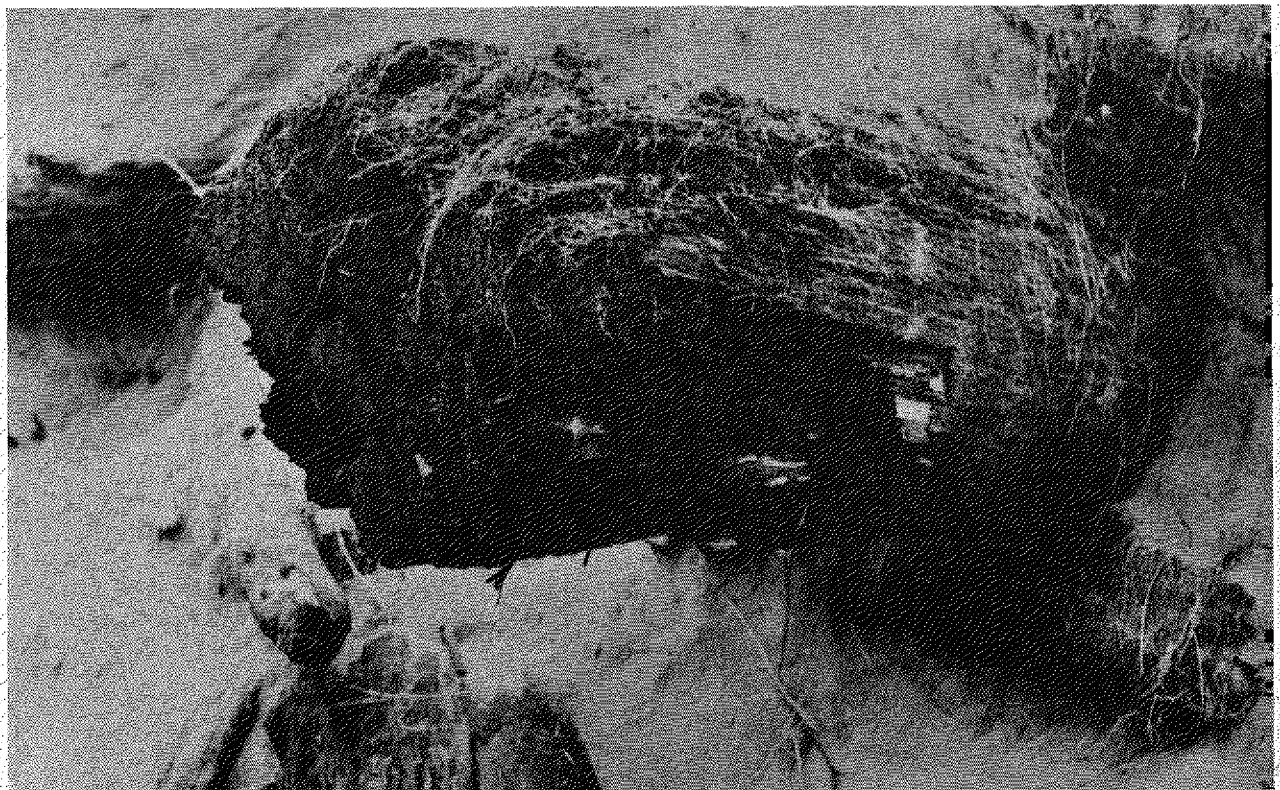
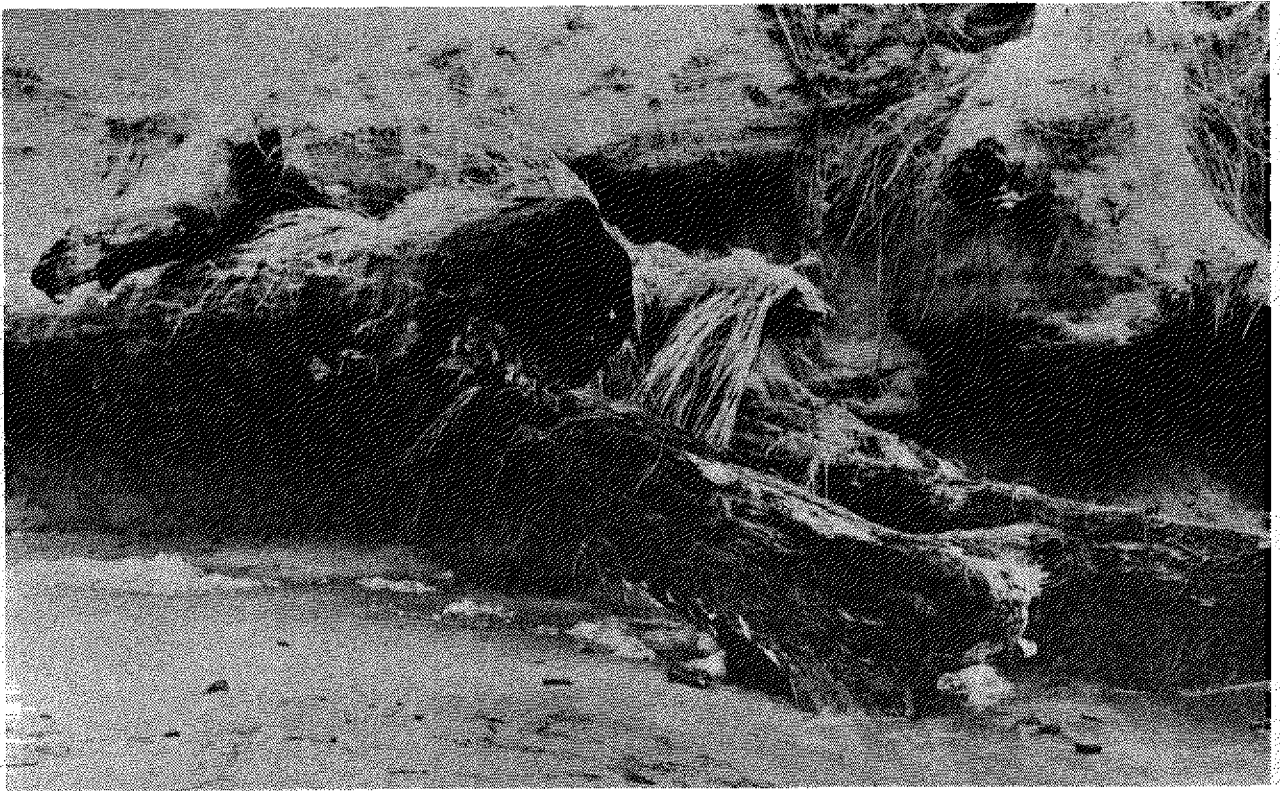


Fig. 6. Logs exposed within the eroded dune bluff, many of which had been sawed.

This indication led to a detailed qualitative study of the spit erosion, using old and recent aerial photographs. Because Siletz Spit has been repeatedly photographed since 1939, some 35 years of coverage are available.

Study of the aerial photographs revealed cycles of erosion and reformation of the dunes. Periodically, sections of the dunes would be eroded away. Like the episode of erosion in 1972-73, this erosion would be localized; it would not extend along the entire length of the spit. Accretion of the dunes could be occurring in one area of the spit while another area was eroding. However, in general there appeared to be an overall predominance of either erosion or dune re-establishment. This is understandable. In a year of many storms on the coast there would be a predisposition toward erosion, but areas with a wide beach might still suffer no dune or property erosion.

The following sequence of events as revealed by the aerial photographs is typical of many cycles of erosion and accretion of the foredunes on Siletz Spit: (1) high waves eroded a vertical scarp in the seaward edge of the foredunes, (2) subsequent high tides deposited drift logs at the base of the scarp, (3) lower energy waves during the summer built a wide beach, (4) the logs behind the beach trapped sand that was either blown off the beach or washed there by the waves at high tide, (5) wind-blown sand continued to accumulate around the logs, sometimes aided by dune grasses, until the foredunes were re-established (Fig. 7 illustrates these processes), (6) erosion again occurred to repeat the cycle.

If uninterrupted, one complete cycle takes some ten to fifteen years. Apparently such cycles of erosion and dune accretion have occurred repeatedly in the past, the 1972-73 occurrence being the most recent episode of the erosion phase of the cycle. The last episode of erosion differed mainly because houses had been built along the landward edge of the reformed dunes. The seaward sides of many houses were on the crest of a healed erosion scarp that had formed as recently as 1962-64. Photographic coverage since 1939 indicates general advance of the foredunes through the early 1950's followed by erosion along most of the spit in the early 1960's. Rebuilding of the dunes began immediately and continued at least through 1967. The erosion that occurred since 1970 represents a return of the erosion phase of the cycle.

Several lessons should be learned from the erosion to Siletz Spit. In sandy foredune

areas of the coast, erosion can occur at any time, removing at least 50 meters (160 feet) of the foredunes. Later the foredunes may become re-established by natural processes. Homes or other structures should not be constructed in areas subject to rapid wave erosion. Adequate set-back lines should be established for such areas, preventing permanent construction. The areas should be left natural and riprap should not be installed when erosion does occur. Natural processes will repair the eroded area by re-establishing the foredunes; riprap is not needed to stop the erosion, only to protect homes in its path.

This study also demonstrates that drift logs play an important role in the natural rebuilding of the foredune areas (Fig. 7). Large-scale removal of the logs for any purpose may be harmful.

#### CAUSES OF EROSION

The shoreline along Siletz Spit is typically very irregular (Fig. 8) due to rip currents carrying sand offshore. Rip currents hollow out small bays on the beach with large cusps between them. At the time of erosion in 1972-73 a strong rip current was situated in one position for most of the winter. This rip current hollowed out a large embayment on the beach, entirely removing the portion of the beach above high tide level so that the wave swash was able to reach the dunes. The loose sands, offering no resistance to the waves, were easily eroded away.

The severe erosion occurred over a short period of time during the last week of 1972 as spring tides were accompanied by strong storm waves. A wave sensor at Newport, Oregon, measured a deep-water wave height of 5.5 meters (18 feet). Calculations indicate that the waves would have had an average wave height of 7 meters (23 feet) when they break on the beach. These are the highest storm waves that have been measured by the sensor since its installation in November 1971.

A predisposition toward erosion on Siletz Spit occurs in winters when a series of storms removes most of the exposed beach, shifting the sand offshore. The actual erosion occurs when a rip current becomes stabilized in one position for a sufficiently long time to form an embayment that reaches up to the foredunes (Fig. 8). Subsequent storm waves are then able to erode away the dunes. This explains the periodic nature of erosion on the spit and why erosion is localized, occurring on only a portion of the spit while other areas are not eroding.

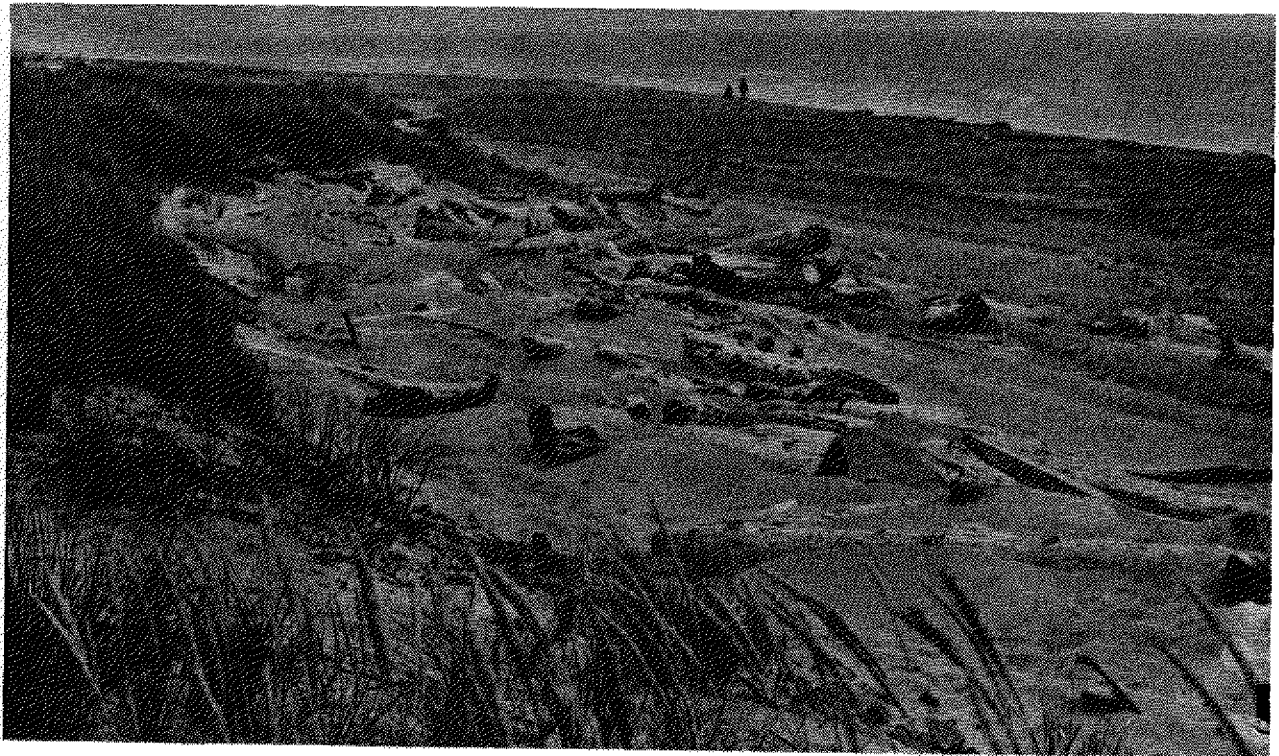
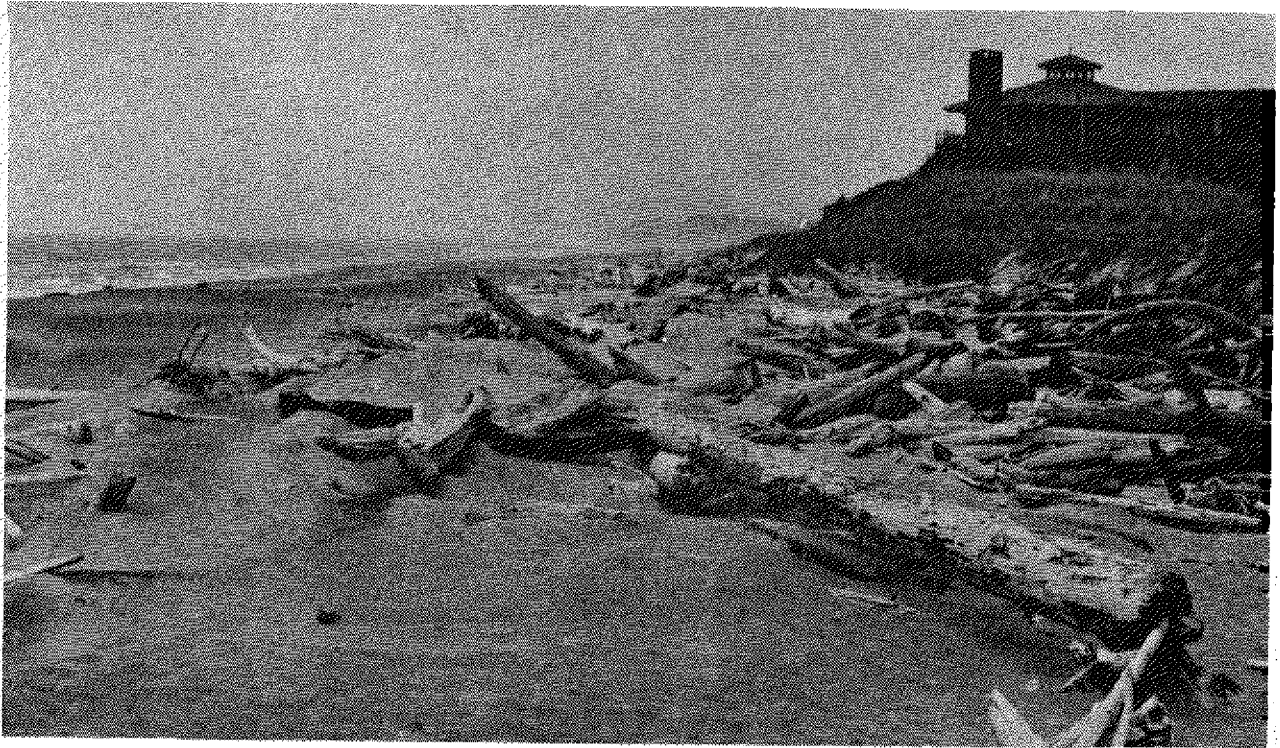


Fig. 7. Logs deposited within small embayments into the foredunes, trapping sands and helping to re-establish the foredunes. The upper photo is the park area which was extensively eroded in 1971 through 1973. The lower photo shows a smaller embayment near the northern end of the spit at a more advanced stage of dune formation.

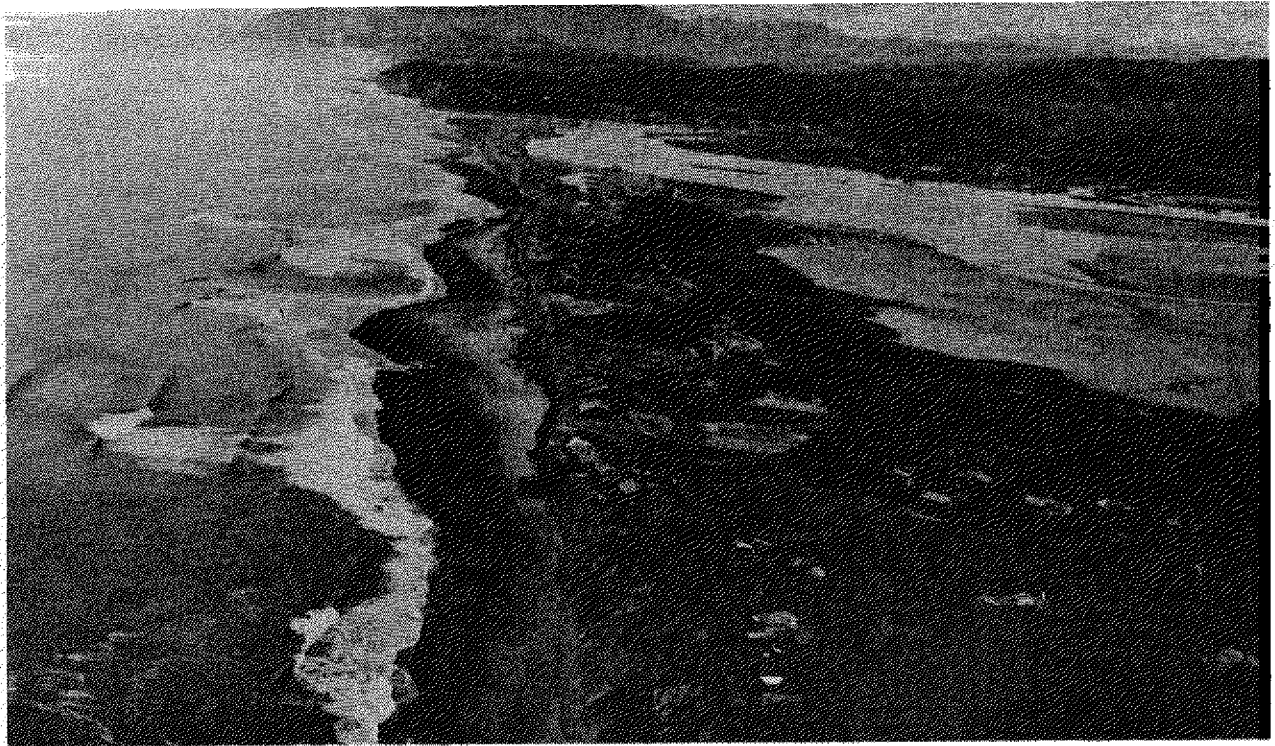


Fig. 8. Irregular shoreline of bays and cusps due to the presence of rip currents, one of which is shown in the lower photograph. These photographs were obtained on February 8, 1973, soon after the erosion occurred. Note that the bay that comes closest to the dunes is at mid-spit, opposite the homes on the riprap promontory.



Fig. 9. Sand mining from the beach at School House Creek, south of Siletz Spit. Sand was removed from the beach at low tide, shown in the upper photo, and piled just inland, shown in the lower photograph. This shows only a portion of the volume removed in a single year. Note the erosion to the sea cliffs in the upper photograph.

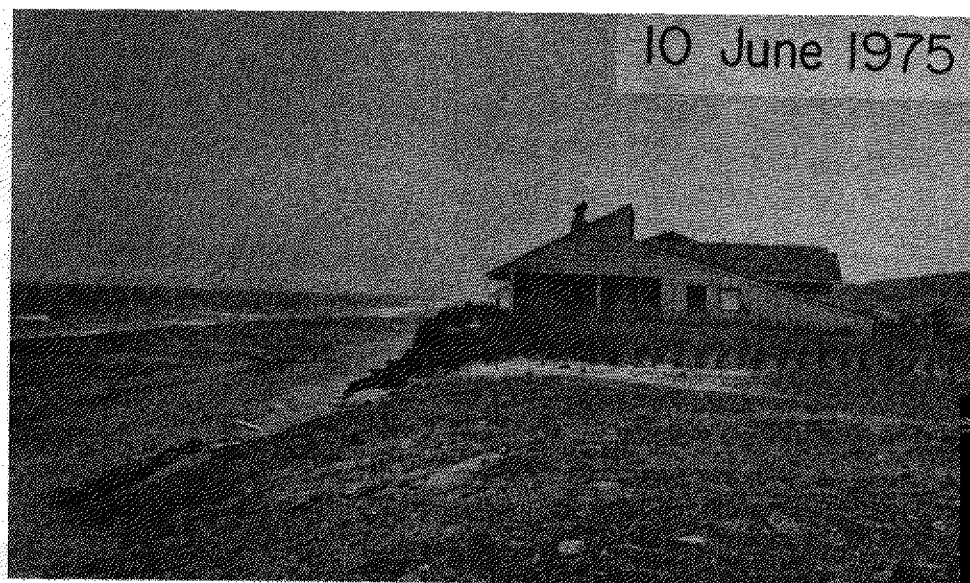
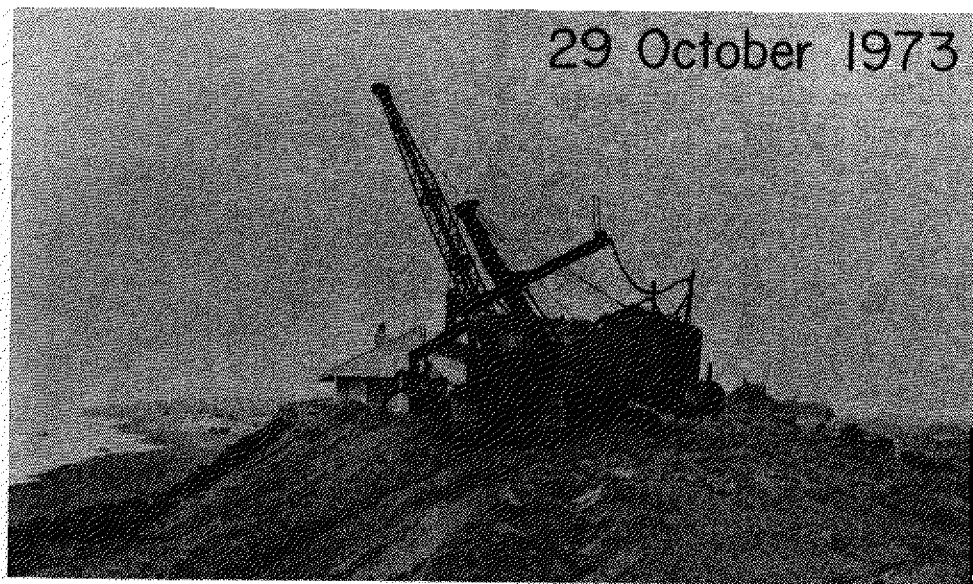


Fig. 10. Restoration of the lots 228 and 229. Compare with Figs. 3 and 4.

Of importance are the positions of the rip currents which change from one year to the next. At the present state of our knowledge we are not able to predict where the rip currents will be positioned; however, once a strong rip current is positioned, we can predict that it is a potential site for severe dune erosion.

The erosion of 1972-73 was more severe than previous episodes of erosion (at least back to 1939); it cut back farther into the dunes. This may have been due to sand mining operations removing sand from the beach just to the south of the spit (Fig. 9). Some

84,500 cubic meters (111,000 cubic yards) of sand were removed between 1965 and 1971.

The beach is composed of coarse sand which has only a small long-term source, principally from erosion of the sea cliffs behind the beach along this stretch of coast except on Siletz Spit itself. The Siletz River carries mainly finer sands unsuitable for the beach. Like the other Oregon estuaries that have been more extensively studied, apparently most or all of this river sand remains in the estuary and is not a source of beach sand. Analyses of beach sand confirm that it is derived from erosion of

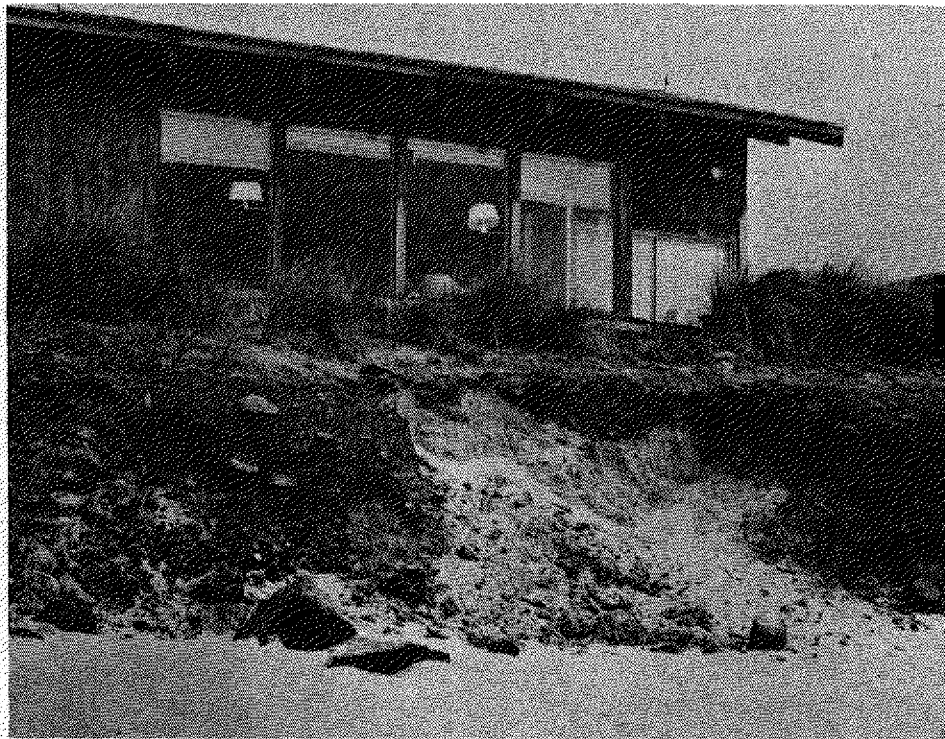
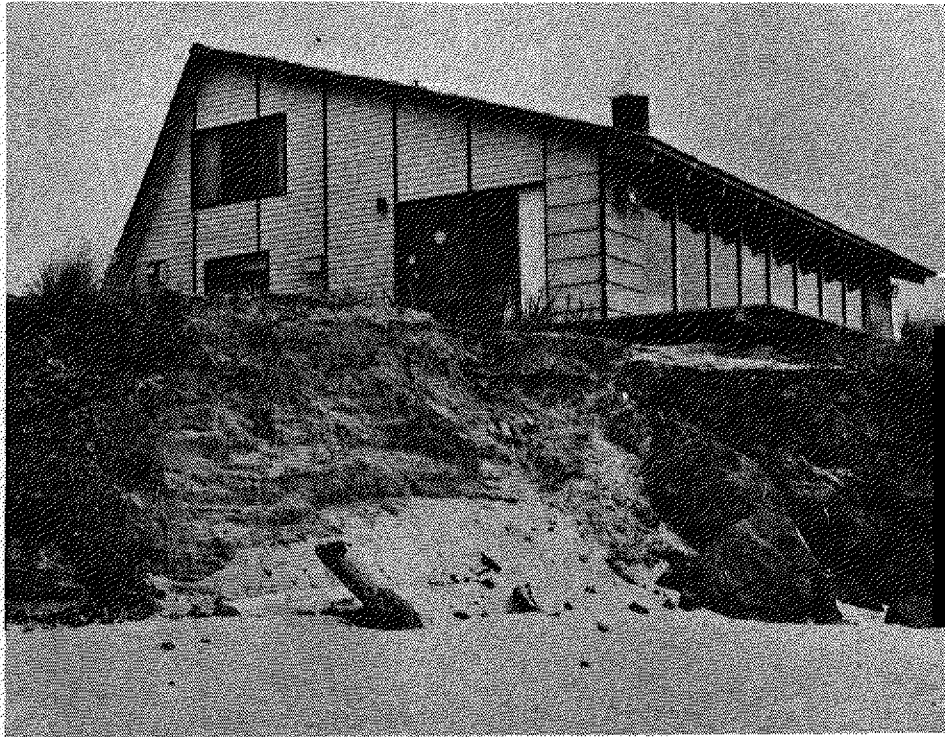


Fig. 11. Erosion of the riprap in front of the homes on lots 230 and 232, exposing some of the dune sands. Note the general small size of the rocks which are easily eroded away.



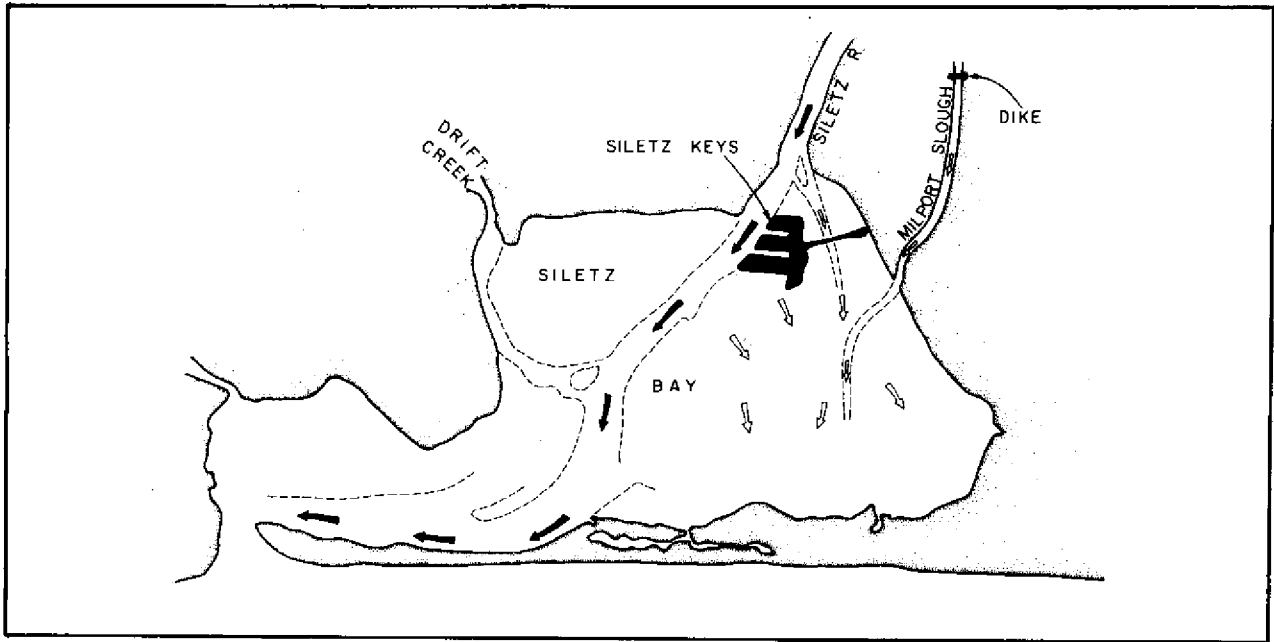


Fig. 12. Siletz River flow through the estuary. The open arrows show how flood waters formerly spilled into the south bay, prior to the diking of the Milport Slough and to the placement of the Siletz Keys fill. Not shown is the fill for the new highway bridge which also prevents spill in the Siletz Keys area. Now all of the flood waters flow down the main channel as shown by the black arrows, directed at the back of the spit.

local sea cliffs. Rocky headlands both to the north and south prevent sand movement alongshore from sources such as the Columbia River. Thus, Siletz Beach is a pocket beach, stretching from Cascade Head on the north to Government Point in the south, with only a small natural source of beach sand.

For these reasons, removal of the sand by mining operations probably disrupted the natural budget of beach sand, the balance of sand gains and losses on the beach. With a decreased volume, the beach was not able to protect the coastal property from wave attack, and accelerated erosion resulted. Therefore, although cycles of erosion to Siletz Spit are natural and are known to have occurred prior to beach sand mining, the mining operations aggravated the situation and caused increased erosion. Beach sand mining has subsequently been stopped.

#### PRESENT STATUS OF EROSION ON SILETZ SPIT

The winters of 1973-74 and 1974-75 were mild with few storms, and the storms that did occur were less intense. Thus erosion has generally ceased, even in areas that have not been protected by riprap.

Some of the lots that were eroded away in 1972-73 have been subsequently restored

(Fig. 10). These are either not protected or inadequately protected; another winter of intense storms could bring renewed erosion. Even some houses that installed riprap in 1972-73 could be endangered by erosion because their riprap protection failed. In some cases the riprap has partially eroded away, even exposing the dune sands (Fig. 11). This riprap was hastily installed in order to save the houses at the time of severe erosion in 1972-73. Its installation did not follow the normal engineering procedures for riprap construction. Even more important, stones of inferior size were used because of their availability; these are easily washed away by waves.

This illustrates another lesson to be learned from the erosion of Siletz Spit. When homes are constructed in sandy areas close to the ocean, there is a strong possibility that erosion may occur. This will necessitate the installation of riprap at considerable expense. Some homeowners have already spent about \$15,000, and more may be required in their defense against the ocean.

It is necessary that the area be uniformly protected with riprap. As we have seen from the experience at Siletz Spit, if your neighbor does not protect his property, the defense will be breached and the erosion may

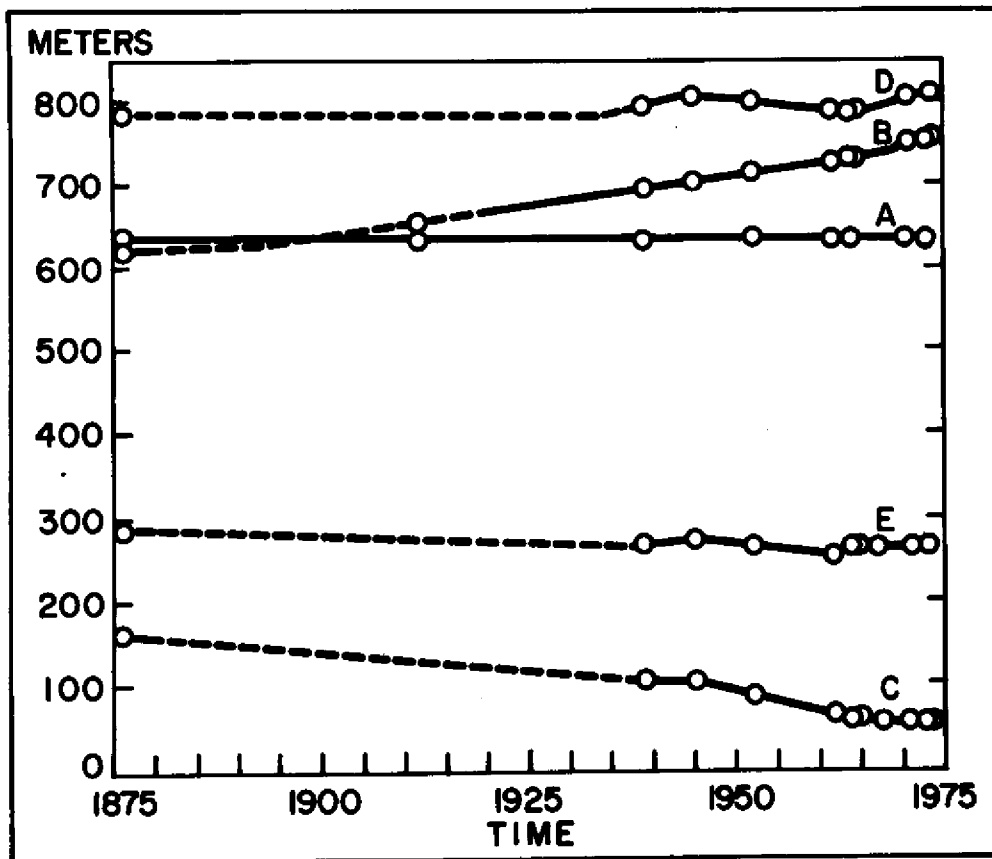
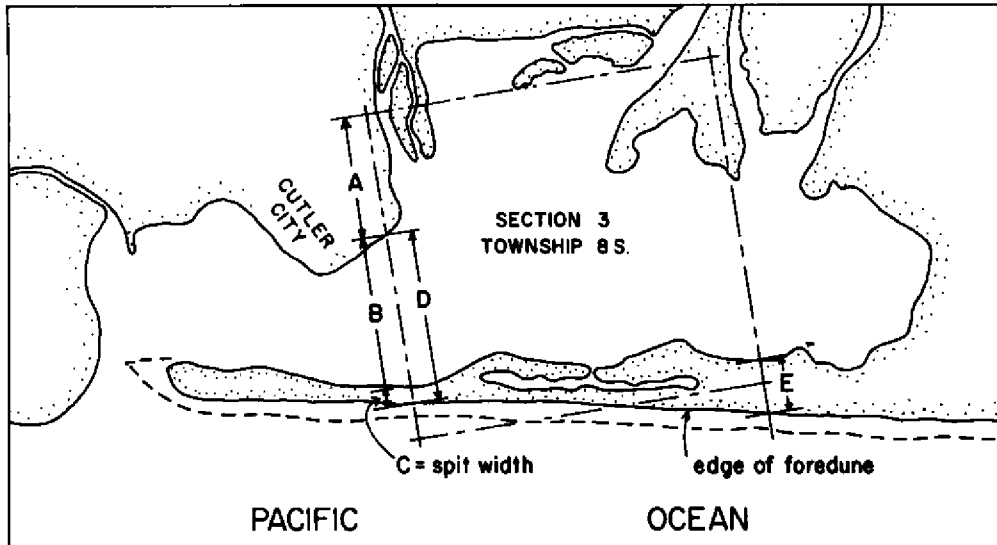


Fig. 13. Data from old surveys and aerial photographs, showing the progressive decrease in the spit width C due to erosion on the bay side.



Fig. 14. Riprap placed on the bay side of the spit to prevent or decrease erosion.

come from the side rather than from the ocean-front of your property. When sand areas near the ocean are developed, it is necessary that the entire area be protected--perhaps by the developer--and not left to individual home or lot owners.

Finally, the necessary placement of riprap acts to limit beach access from the homes. Riprap also interferes with the scenic aspects of the coast that draw people to the beach. Again, if adequate set-back lines are established, riprap would not become necessary.

#### EROSION TO THE BAY SIDE OF THE SPIT

Erosion has also been occurring on the bay side of the spit where the flow of the Siletz River through the bay impinges on the spit near its north end (Fig. 12). The progress of this erosion was studied with aerial photographs and old surveys dating back to 1875, the original survey of this area. Fortunately, one of the section lines passed directly across the eroded area (Fig. 13). This provided measurements of the distances A, B, C and D in Fig. 13. These same distances were measured on the series of aerial photographs dating back to 1939. The results are shown in the graph of Fig. 13.

In 1875 the width of the spit, C, was

163 meters (535 feet). By 1939 it had decreased to 102 meters (335 feet). Presently it is only 52 meters (171 feet) wide. The progressive increase in the distance B across Siletz Bay shows that the 111 meters (364 feet) decrease in the spit width was due entirely to erosion on the bay side. The edge of the foredunes (taken as the seaward limit of the spit width) fluctuated somewhat in position due to the cycles of erosion and dune reformation discussed above, but did not change its overall position in those 100 years. This is reflected in the wavy nature of the distance D in Fig. 13. The erosion on the bay side appears to have been fairly steady until recently when riprap was installed to stop the erosion (Fig. 14).

It is difficult to determine exactly when this erosion began. If the rate of erosion between 1939 and the present (just prior to riprapping) is projected backward through time, the results indicate that it began about the turn of the century. Historical evidence such as settlers' comments on channel migrations and clam populations within the bay support this time as the beginning of the erosion. Its beginning may have been due to a natural meandering of the Siletz River channel within the bay. Occurring simultaneously with settling, logging and farming in the drainage basins of the rivers, it may

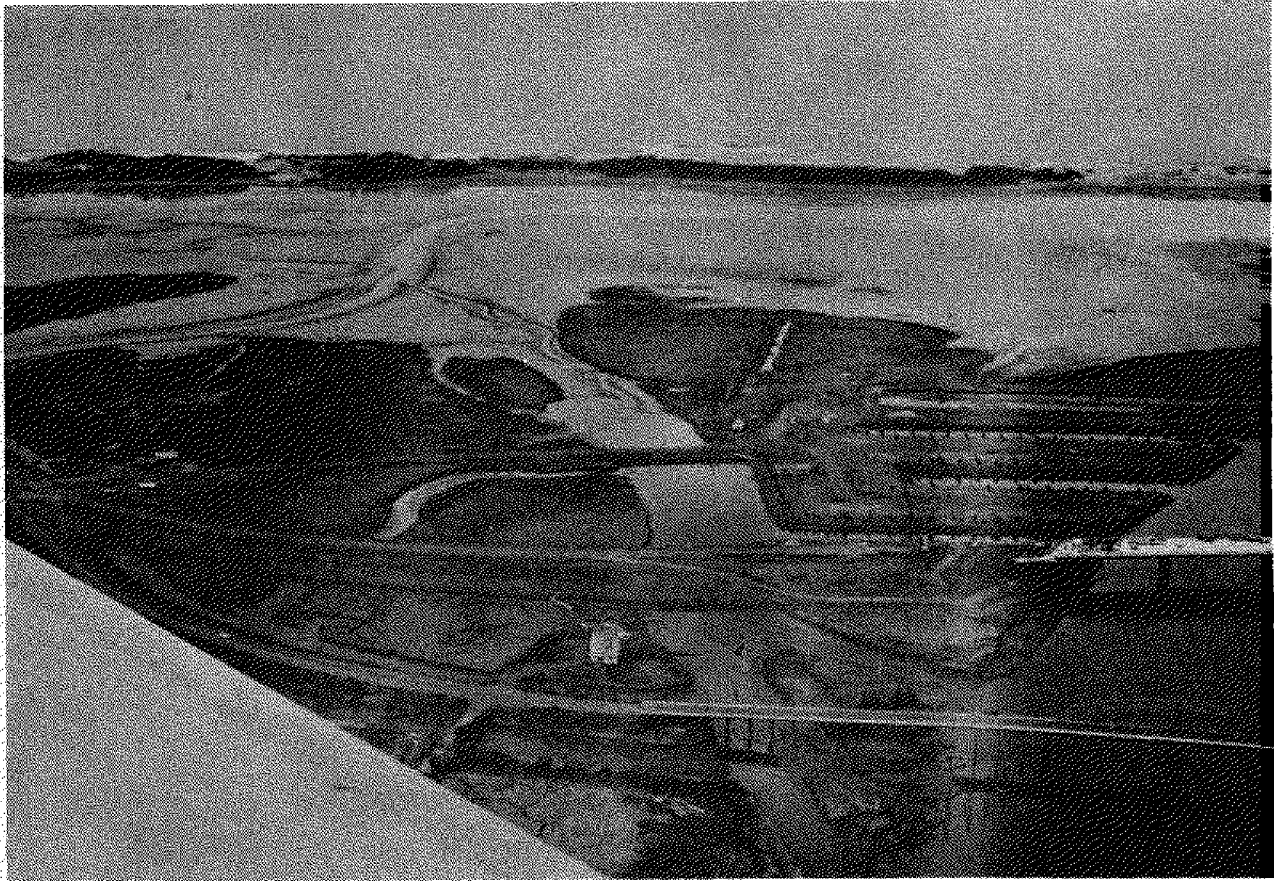


Fig. 15. Aerial view of the Siletz Keys fill and the approaches to the old and new highway bridge. Note how the access road to the Siletz Keys and the approach to the new bridge both block the channel leading to the south bay.

be that a sudden increase in siltation within the bay caused the channel migration. There is some evidence that a delta built by Drift Creek pushed the Siletz River over against the spit.

Recent landfills in Siletz Bay have probably aggravated the erosion problem. These are shown in Figs. 12 and 15. Both the Siletz Keys fill and the dike on the Millport Slough prevent flood discharge spill into the south bay. Prior to these fills, flood waters would flow in part into the south bay and dissipate the energy of the flood waters. Now that this spill is prevented by the fills, the full flood discharge of the Siletz River is directed toward the back of the spit, into the area that is eroding. The expected increase in erosion has been reduced by the installation of riprap, but it is question-

able whether the riprap will continue to be effective.

Removal of the dike on the Millport Slough would eliminate in part this aggravation and would improve water circulation in the south part of the bay. Removal of the dike-entrance to Siletz Keys is no longer sufficient as the recent construction of a new bridge for Highway 101 over the Siletz River has also blocked that spill channel (Fig. 15). A conduit under the approach to the bridge would also be necessary.

Landfills within bays and estuaries not only have an effect on the ecology of the area and change the water circulation, but changes in water flow may also cause serious erosion of shorelines in the bay as seen at Siletz.