

THE OHIO JOURNAL OF SCIENCE

VOL. LI

JANUARY 1951

No. 1

SHORE EROSION ON SANDUSKY BAY

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The south shore of Sandusky Bay is undergoing severe erosion as a result of wave attack, and represents but one of a large number of badly eroded places along the south shore of Maumee Bay, Sandusky Bay, and Lake Erie (Fig. 1).

The geology of the area was studied as a co-operative project of the Geological Survey of Ohio and the Lake Erie Division of the Ohio Department of Public Works. The field work was done during August of 1946. The area, approximately 2 miles long, embracing the most southerly portions of Sandusky Bay has been designated Critical Area 34 by the Lake Erie Division of the Ohio Department of Public Works.

The area studied extends from the western boundary of section 5, Townsend Township, Sandusky County, Ohio, across section 4 of the same township. The eastern limit of the area lies approximately 2200 feet in a northeasterly direction from the western point of the wedge-shaped projection of the western border of Erie County, Ohio. The area lies in the Lake Plain section of northern Ohio, the general level of the surface along the shore of the bay being 580 feet above sea level (U. S. G. S. datum). The surface of the Lake Plain section rises very gradually southward at the rate of 8-10 feet per mile.

Critical Area 34 is drained by several ditches which flow northward into Sandusky Bay.

BED ROCK

The area is underlain by the Tymochtee shaly dolomite member of the upper Silurian, Bass Island formation (Carman, 1927, p. 488). The Tymochtee does not outcrop in the area and is overlain by glacial till and lacustrine clay. The owner of a 6-inch water well completed in the summer of 1946 at Perry's Harbor, White's landing, at the eastern end of the area, reported that bed rock was first encountered 25 feet beneath the surface. This depth to bedrock is in keeping with other records in the area.

GLACIAL DEPOSITS

The entire basin of Lake Erie has been covered by at least two of the ice sheets of Pleistocene age. The bedrock in the area studied is overlain with a thin covering of glacial till, which is overlain by about 20 feet of lacustrine clay. In the eastern part the till is about 5 feet thick according to the reported log of a well drilled nearby.

The till is a moist, soft, calcareous clay with very small rock flakes and pink streaks at the top grading downward to a blue-gray clay containing pebbles. Eastward on Lake Erie where the till outcrops it is a hard, compact, clay with rock fragments ranging from sand size to cobbles and boulders.

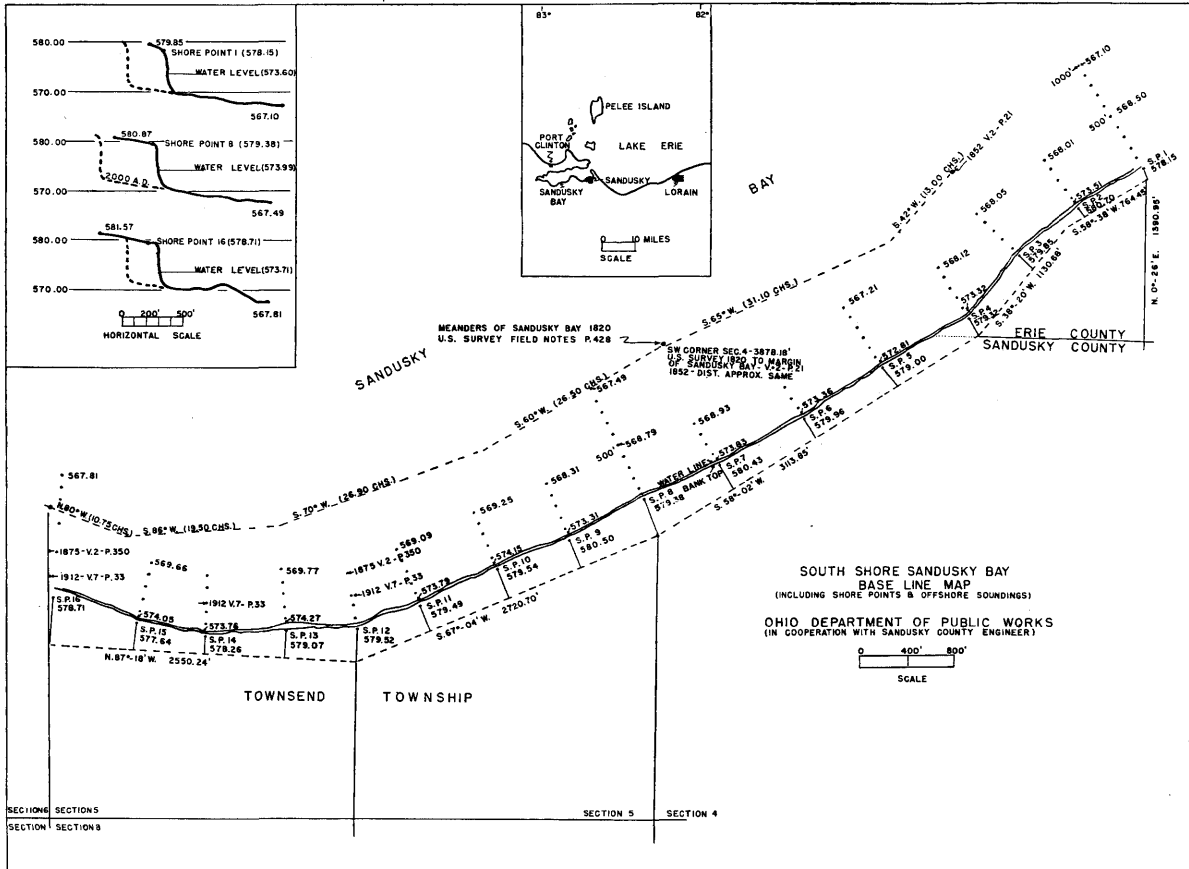


FIG. 1. The 1820 and 1945-1946 Meander Line of Sandusky Bay in the area studied. Insets show location of Sandusky Bay and Profiles at selected Shore Points.

A mechanical analysis of the very top of the till layer showed about 82 per cent of silt and clay sized particles and only 2.1% of material larger than 2 mm. Although the till is rather fine-grained it contains a higher proportion of coarse and fine sand than is found in the lacustrine clay described later.

GLACIAL AND POST GLACIAL LAKES

Introduction

Critical Area 34 and all of Sandusky County, except a very small area in the southeastern corner was covered by the waters of glacial lakes. Beach ridges of sand and gravel, representing offshore bars or shore lines of three of the glacial lakes—highest Maumee, Whittlesey and Warren, are present in the southeastern portion of Sandusky County.

Lacustrine Deposits

In the glacial lakes silts and clays were deposited over the underlying thin glacial till. Some of the material came from finely ground material in the dirty under portion of the ice, and some came from shore erosion on the land areas to the south.

Lacustrine clay forms the surface material everywhere in the area. It composes all of the 7 feet of material in the low cliffs along Sandusky Bay, and continues to depths of 20–22 feet below the surface, below which glacial till occurs.

The fresh lacustrine clay is silty clay, blue-gray in color, with some yellowish-brown mottling, especially in the upper 10–12 feet, and always shows at least faint lamination.

Wilson (1943, pp. 195–197) interpreted the lacustrine clays as varved clays. From studies of his thickest core (which reached bedrock) taken a few feet beyond the southern edge of Sandusky Bay on Lake Erie he counted 12,223 varves in a total thickness of 37' 7." He concluded that the Sandusky Bay region was covered by waters of the glacial lakes for a minimum of 12,223 years. White (1943, p. 39) described the lacustrine clay at the western end of Lake Erie as follows:

"The lacustrine clay is a very weak and easily eroded material. It is affected by frost action, by slaking upon drying in newly exposed bluffs, by rain wash, and by wave attack. The waves remove first the crumbly outer surface produced by frost action and by slaking, leaving a new surface to be further affected by frost and drying. . . .

"When eroded, the silt and clay are readily carried to deeper water, and the sand in the material is so very small in amount that it makes no significant contribution to the beach."

SHORE EROSION

Shore erosion along Lake Erie and in Sandusky Bay has long been observed. Moseley (1905, p. 179) pointed out the damage to the south shore of Sandusky Bay during northeast storms of 1857–1862 and subsequent years.

From U. S. Survey Field Notes the Sandusky County Engineer's Office was able to determine the margin of Sandusky Bay in the years 1820, 1875, and 1912 along section lines. During the summers of 1945 and 1946 the Lake Erie Division of the Ohio Department of Public Works in co-operation with the Sandusky County Engineers surveyed a base line along the south shore of Sandusky Bay marked by "Shore Points" consisting of pipes set in concrete. The 1945–46 meander line was placed on a tracing and the points along the margin of the bay in the surveys of 1820, 1875, and 1912 were added (Fig. 1).

Along the western border of section 5, Townsend Township, the present shore is about 650 feet farther south than in 1820.

Along the line between sections 4 and 5 of the same township the present margin of the bay is about 1150 feet south of its position in 1820.

The easternmost point of the 1820 survey is about 825 feet from the nearest point on the present shore.

At the point of least retreat (western boundary of section 5) the south shore of Sandusky Bay in Critical Area 34 has been retreating at an average rate of 5.2 feet per year for the past 125 years. At the point of greatest retreat (western boundary of section 4) the shore has been retreating at an average rate of 9.2 feet per year for the past 125 years.

The retreat of the shoreline and enlargement of the bay does not proceed at a uniform rate. Cycles of high water in Lake Erie are evident from the hydrographs compiled by the U. S. Lake Survey. During cycles of high water more rapid erosion of the shore materials occurs. Northeast storms pile water up in the bay and then destruction by waves is severe. Moseley (1905, p. 188) points out that only once in several years is the water level raised or lowered from its normal level so much as 3 feet at Sandusky and extreme fluctuations of 6 or 7 feet at each end of the lake are rare. A change of only several feet, however, would greatly increase the erosive power of the waves. Northeast storms occurring during cycles of high water are especially destructive. During severe northeast storms when the water level is high the water may encroach upon the land at a very rapid rate, then for a period of several years there may be practically no loss of shore materials. The shape of the shoreline and its trend also affects the rate of loss.

FUTURE SHORELINE

Movement of the present shore

Early in the history of Lake Erie, according to Leverett, (1931, p. 101) the area now covered by the waters of Sandusky Bay was occupied by the Sandusky River and its tributaries. Progressive submergence of the western end of the Lake Erie Basin and the mouth of the Sandusky River formed Sandusky Bay. Wave erosion has steadily contributed to the enlargement of the bay. The course of the Sandusky River and its tributaries across Sandusky Bay was carefully determined by Moseley (1905, p. 202). He correctly interpreted the present shoreline as one of submergence and Sandusky Bay as the drowned lower valley of the Sandusky River.

The rate of submergence of the western end of Lake Erie has been studied by several authorities and various rates of change in the land surface proposed. Gilbert (1898, p. 639) makes the following statement: "The water also advances on all shores of Lake Erie, most rapidly at Toledo and Sandusky, where the change is 8 or 9 inches a century." Moseley (1905, p. 235) calculated the rise of water caused by tilting of the land to be 2.14 feet per 100 years at Sandusky. Gutenberg (1933, p. 455) quotes Freeman as estimating the rate of water rise at about 0.5 foot per 100 miles per 100 years. Moore (1948, p. 705) points out that the entire Great Lakes area is subsiding with respect to sea level, the least subsidence on Lake Erie is at the outlet at Buffalo and the greatest subsidence is at Port Clinton, about 6 miles directly north of the area studied on Sandusky Bay. He further points out that Lake Erie is gaining in volume so that there is encroachment of water on the land along the entire shore line.

As subsidence continues Sandusky Bay will become wider and longer and more of the Sandusky River will be submerged. As the bay grows in size shore erosion will take place more rapidly since the waves will attain greater size and force.

Future shorelines

Opposite shore points 1, 8, and 16 (Fig. 1) offshore borings and soundings were made. Samples of the bottom sediment were taken to a depth of 4 feet below the bottom of the bay, and profiles of the bottom were constructed. Different water levels represent different times of study.

The profiles are extended to show the position of the shore in the year 2000

A. D., if the shore materials at these locations continue to be removed at the average annual rates that have occurred since 1820.

The rates of retreat used for projecting the profiles into the future are conservative, and the position of the shore in 2000 A. D. may well be farther inland than shown, as subsidence of the western end of the Lake Erie Basin will probably continue in the future, adding to the size of Sandusky Bay and increasing the rate of encroachment of the water on the land. It may be expected that cycles of high water in Lake Erie and Sandusky Bay will continue in the future, and northeast storms will sometimes occur during periods of high water.

Lowering of lake level by engineering works, or the construction of extensive shore protective devices in Sandusky Bay could slow the rate of shore erosion. Without these the bay will continue to become longer, wider, and shallower.

ACKNOWLEDGMENTS

The writer is indebted to Dr. George W. White, former State Geologist of Ohio, to the late Mr. W. H. Gould, State Agent for the Lake Erie Division, Ohio Department of Public Works, and to Mr. D. W. Gould who furnished valuable assistance in the field and information on the area studied. The Ohio Department of Highways made the grain size analyses of the materials collected. Mr. John H. Melvin, State Geologist of Ohio, gave permission for publication of some of the data.

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