University of Wisconsin-Extension

GEOLOGICAL AND NATURAL HISTORY SURVEY
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A GEOLOGICAL RECONNAISSANCE OF BENDER COUNTY PARK, MILWAUKEE COUNTY, WISCONSIN

by

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Introduction

At the request of Mr. Don Herman, mayor of Oak Creek, Wisconsin, the Geological and Natural History Survey conducted a reconnaissance survey of Bender County Park, Milwaukee County, Wisconsin.

The survey, which was conducted on September 27 and 30, 1974, was designed to investigate the geology of the site, to relate the geology to the rapid shoreline erosion occurring at the park, and to evaluate the potential of the park as a site for the construction of a marina.

General Setting

Bender Park lies in extreme southern Milwaukee, County, about a mile north of the Milwaukee-Racine County line. The park has a frontage along Lake Michigan of about $1\frac{1}{4}$ miles, lying in sections 24, 25, and 36, T.5N., R.22E.

Steep bluffs ranging up to 100 feet in height border the park on the lake side. These bluffs are interrupted by two major ravines, one heading just south of Oakwood Road near the southern edge of the park, and the other heading about 1000 feet south of the end of Ryan Road near the northern border.

A narrow beach borders the foot of the bluffs for about a quarter of a mile north of the south boundary of the park. North of this point, there is little or no beach.

At the time of the investigation, the park was undeveloped.

Method of Study

The geology of the park was investigated through study of the materials exposed in the ravines, along the beaches, and in the face of the bluffs. Due to the lack of beaches along large segments of the shoreline, examination of the foot of the bluffs was limited to about 1600 feet north of Oakwood Road, and about 1000 feet south from the ravine at Ryan Road. The full face of the bluff was examined at several points near the south limits and at two points near the northern end of the park. Due to the prevalence of high vertical faces cut into the lower portions of the bluffs throughout the central part of the shoreline, only partial traverses of the bluffs were possible in this area. Both ravines were studied in their entirety.

Geology of the Bluffs

Over much of the study area the face of the bluff appears to be made up of a single unit of glacial till. This till is silty, relatively well consolidated, and has a well developed system of vertical and horizontal cracks or joints. In spite of the compact nature of the till, it appears to be readily eroded by both wave action and surface runoff.

The till at the top of the bluffs has been weathered to a depth of about ten feet and is significantly lighter in color and much less compact than the underlying fresh till. The surface of the till exposed in the bluffs is, with the exception of freshly cut, near vertical exposures, covered by a layer of porous clayey silt several inches thick. This thin masking veneer appears to be mainly the result of the disruption of the surface of the till through wetting and drying, and freezing and thawing. Some of this silty cover may also be due to material washing down from the weathered zone at the top of the bluff.

At a number of places along the base of the bluffs, the till is underlain by a layer of clayey silt. Where exposed at the northern end of the park, the silty bed is about a foot thick and shows very indistinct horizontal stratification. At the southern end of the park, the silt is conspicuously laminated and reaches a thickness of as much as 15 feet. Along much of the shoreline, the silt is either missing, or more probably, covered by large blocks of the overlying till which have slumped down to the water level.

Figure 1 shows the contact between the silt and the overlying till. The point of the entrenching tool at the left edge of the photograph is at the contact. Notice the conspicuous vertical joints or cracks in the till unit, and also, the fact that these cracks do not carry through into the underlying silt.

Several lenses of sand were also observed, but they appeared to be of very limited extent and were not water bearing. There is also some evidence for a second silt layer lying about half-way up the slope in a portion of the northern 1/3 of the bluff. This bed was never seen in place, but at several locations, blocks of silt were found in material that had slipped down from high portions of the bluff.

Beach Erosion

As was stated earlier, there is a narrow beach along the base of the bluff at the southern end of the park, while little or no beach is found to the north. This distribution of beaches is probably primarily due to the presence of large structures extending into the lake to both the north and south of the park.

Figure 2 is a view from the top of the bluff near the southern end of the park looking south, and showing a large power plant extending out into the lake. The power plant has obstructed the southerly flow of sediments along the coast and as a result, a beach has formed. This beach extends from the power plant northward to a point almost directly below the spot from which this photograph was taken.

Figure 3 is a view of the shoreline to the north of the plant, and was taken from the top of the bluff near the northern border of the park. Here again we see large structures jutting out into the lake and largely blocking the southerly flow of sediments. The lack of beaches in the area to the south of these structures is almost certainly due in large part to this interference with the natural movement of sediments along the shoreline. Figure 4 shows the foot of the bluff near the northern border of the park. Due to the absence of protective beaches, the waves are breaking directly against the base of the bluff.

Erosion of the Bluff

The rapid erosion of the bluffs in the Bender Park region is the result of the combined effects of a number of factors. Principal among these are:

1. High water levels in Lake Michigan.
2. The lack of protective beaches.
3. The comparative ease with which the till and silt exposed at the base of the bluffs are eroded.
4. The well developed joint system in the till.
5. Ground water seepage.

On the basis of the features observed at the park, the sequence of events leading to slope retreat is believed to be as follows:

Erosion is initiated by wave action at the base of the bluff. Waves undercut the overlying till, the vertical joints in the till near the exposed face open as tension cracks, and blocks of till drop to the base of the bluff and are removed through continuing wave action. This leads to the formation of nearly vertical cut faces such as that shown in Fig. 1.

Continuing erosion at the base of the bluff removes lateral support for the overlying material, leading to the type of slope failure known as slumping. In this type of failure, large masses of earth, often hundreds of feet long and involving the full height of the bluff, become detached and slide downward and outward along a curved failure surface.

The first manifestation of slumping is often the appearance of an open crack at the head of the slump block, running roughly parallel to the trend of the bluff. An excellent example of such a crack is shown in Fig. 5. Movement of the slump block usually occurs in conjunction with major storms. This is probably due both to rapid erosion of the base of the slope by storm waves, and tothe build up of pore water pressure in the soil due to the heavy rains. Figure 6 shows a slump block that has moved 10 to 15 feet downslope. The movement shown in this photograph has taken place along a continuation of the crack shown in Fig. 5. A composite view of the features described above is shown in Fig. 7. Notice the steep wave cut cliff at the water line, and the scarp at the top of the slope that shows the movement of extremely large slump blocks.

The Role of Ground Water

As was shown on Fig. 1, the thick till unit that forms the bluff is underlain by a unit of clayey silt. In several spots, especially at the north end of the park, a line of springs was observed at the contact between the two units. It appears that water moves down the joint system in the till until it is blocked by the relatively impermeable clayey silt, and then moves laterally along the

contact to the face of the bluff. As the result of the accumulation of water at the contact, a saturated zone has formed in both the upper portions of the silt and in the lower few inches of the till. This saturated zone appears to be the seat of most of the observed slumping. This is especially obvious in the area lying between Oakwood Road and the power plant. Here it can be seen that numerous slides have taken place, even though the base of the slope is relatively well protected from wave erosion by the wide beach that has accreted in this area.

Possible Development of the Park

Bender Park is an area undergoing extremely rapid shoreline erosion, aggravated by adverse conditions of groundwater movement. Unless corrective measures are taken much of the park will be lost.

In its present state of development, the extensive shoreline of the park is of very limited recreational value. There are no beaches along most of the shoreline, and even where present, the extremely unstable nature of the bluffs would make use of the narrow beaches at their base hazardous. In addition, there is no safe access to the lake level.

Protection of the shoreline, and development of the park would be an extremely expensive task, involving construction of protective structures, re-grading of the bluffs, and the implementation of some scheme for draining the saturated zone at the till-silt contact. If the decision to develop the park is made, however, the inclusion of the contemplated marina could be a major positive factor in the development, since a properly designed marina could serve to hold a beach and thus provide the backbone of a shoreline protection system. If considered in the context of the overall costs for development of the park, inclusion of a marina would probably be one of the less costly items.

Figure 1

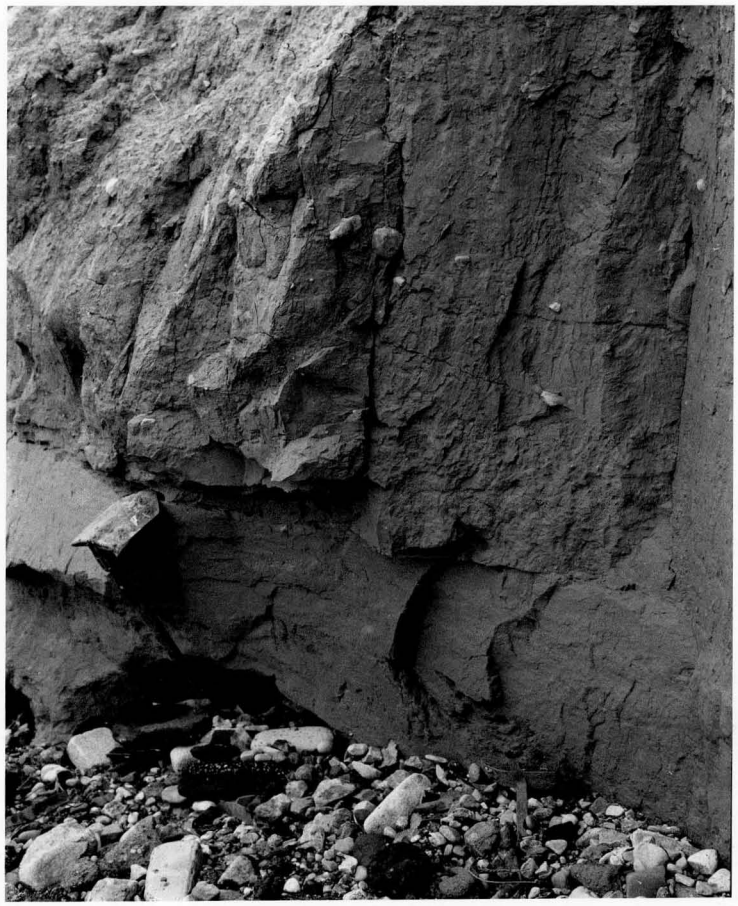

Figure 2

Figure 3

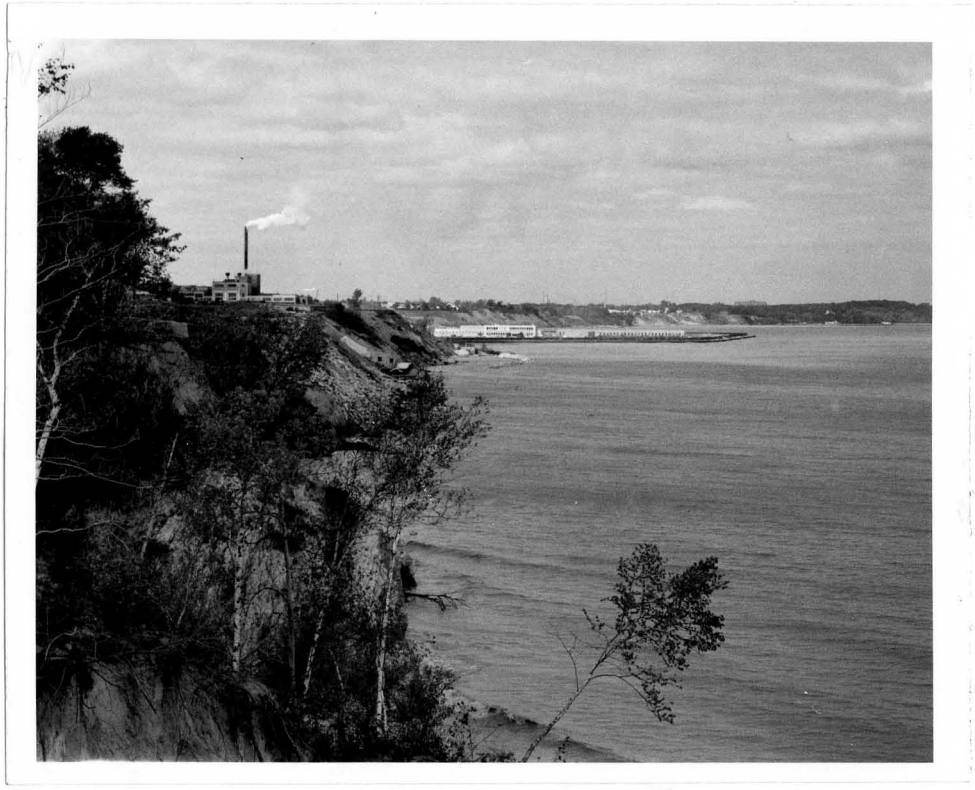

Figure 5

Figure 6

Figure 7