

4

Coastal Erosion Assessment and Planning

The Lake Michigan coast is a dynamic setting influenced by waves, ice, and changing lake levels. The potential for coastal erosion exists along nearly the entire Illinois coast. This chapter discusses coastal erosion, how it has been addressed in the past, and how coastal erosion assessment and planning will occur in the ICMP.

Two aspects of coastal erosion along the Illinois coast are important for understanding past, present, and future erosional trends.

- Coastal Erosion in the Natural Setting

Prior to any human modifications, the natural setting along the Illinois coast was nearly all erosional (Chrzastowski, Thompson and Trask 1994). There was an abundant supply of littoral sand moving along the shore. However, this sand was in transport to a depositional zone along the central Indiana coast. The exception to the erosional trends was the southern part of the Zion beach-ridge plain from near the mouth of Dead River southward to the North Chicago shoreline. This was the state's only accretional shore. The accretion resulted from the southward translation of the beach-ridge plain.

- Lake Level Influence on Coastal Erosion

Erosion along the Illinois coast gains considerable public and media attention during times of high lake levels. High water causes partial to total submergence of some beaches; storm waves can damage and overtop shore structures, and localized coastal flooding may occur. A common misconception is that coastal erosion is limited to times of high lake levels. Erosion can be an ongoing process regardless of lake level. Changing lake levels simply shift the erosion zone either landward or lakeward.

Four Categories of Illinois Coastal Erosion

Four categories of coastal erosion have been, and continue to be, an issue along the Illinois Lake Michigan coast and inland waterways: Shore, bluff, lakebed, and waterway bank erosion. These correspond to different locations on the topographic/bathymetric profile.

- Shore Erosion

Shore erosion impacts the exposed beach or land area adjacent to the shoreline. It results in a landward translation of the shoreline, loss of beach area, and sand volume. A related process to shore erosion is the damage and deterioration of engineered structures that occur along the shore

such as revetments, riprap, groins, bulkheads and breakwaters. Because of the important role of shore protection structures to stabilize the land/water interface, damage and deterioration of these structures can be equally important as any beach area or land area erosional loss.

- Bluff Erosion

The Illinois bluff coast was near continuously eroding (e.g., Atwood and Goldthwait 1908; Illinois Division of Waterways 1958). The bluff erosion commonly involved wave erosion cutting into the toe of the bluff and undermining the bluff slope. The bluffs could also erode due to either surface runoff or ground water moving over or through bluff materials. In the late 1970s to 1990s, substantial shore protection was installed to halt bluff erosion. By 2000, a survey of the bluff coast determined that wave-induced bluff erosion was active along no more than about 600 feet of the entire bluff coast (Chrzastowski 2000).

- Lakebed Erosion

“Lakebed erosion” refers to underwater erosion across the bed of the lake. This erosion does not refer to the sand or gravelly sand that may occur along the lake bottom. Lakebed erosion refers to the erosion across the cohesive layers of glacial till or clay that underlie the sand. This type of erosion is also referred to as “Lakebed downcutting,” or simply “Downcutting.” The cause is wave and current action, as well as ice.

Lakebed erosion is non-reversible because the loss of cohesive material cannot be replaced other than by a new glacial episode. The long-term impact of lakebed erosion is the lowering of the lake-bottom profile. As a result, deeper water occurs closer to shore, and the profile is steeper between the beach and nearshore. The deeper water, and steeper profile, allow larger waves to impact the shore. This can increase the potential for erosion along the beaches and the toe of the bluffs.

- Waterway Bank Erosion

Banks along the inland waterways are subject to erosion by undermining, and slope instability. Bank erosion can result from natural processes, or human activity such as from boat wakes.

Historical Mitigation of Coastal Erosion

A variety of coastal erosion mitigation approaches along the Illinois coast have been used over time. Hardening the shore with engineered structures is the most common practice. In recent decades, there has been greater interest in using “soft” solutions to retain sand volume, such as beach nourishment alone or in combination with hard structures to retain sand volume.

- Shore-Protection Structures

A variety of shore-protection structures occur along the Illinois coast such as groins, riprap, revetments, and breakwaters. Many of the early shore-protection structures relied on timber to form the walls for rock-filled cribs in breakwaters and groins. Steel sheetpile is now the primary material for facing groins, jetties, and the base of stepped revetments. Quarry stone and reinforced concrete are also common materials.

Headland Beach Systems, are a type of shore protection that also provide recreational and aesthetic benefits. These engineered pocket beaches are held by groins or rubble-mound breakwater headlands. These beach systems have the advantage of: 1) creating a contained beach that is not dependent on any influx of sand from littoral transport, and 2) creating a beach that will minimize loss of sand to littoral transport. The headland beach systems have been used extensively on the bluff coast along private residential properties.

- Lakefill

Filling in the shallow nearshore area to create new land and establish a more lakeward shoreline position has been used as a means of shore protection, particularly along the Chicago lakefront. The lakefill results in a durable new shoreline edge that can be built to withstand direct wave and ice impact, and be more erosion-resistant than the pre-lakefill shoreline.

- Beach Nourishment

Beach nourishment is used along many of the municipal beaches and, to a limited degree, along private lakeshore properties. The most rigorous beach nourishment is done at Illinois Beach State Park. Maintaining the state park shore to be free of any additional shore protection, or offshore structures, is a long-term coastal management objective for the state park (Illinois Department of Natural Resources 2001).

Permitting Projects for Coastal Erosion Control - *General*

Two agencies are responsible for reviewing and permitting construction along the Illinois coast. They also are responsible for controlling coastal erosion. On the state level, permitting is done by the Office of Water Resources (OWR), Lake Michigan Management Section, of the Illinois Department of Natural Resources (IDNR). On the federal level, permitting is done by the USACE, Chicago District Regulatory Branch. In general, for both agencies, no projects are permitted that are deemed potentially disruptive to the movement of littoral transport along the beaches and nearshore areas. An exception to this restriction might include structures that will trap sand, but will have a sand management plan, which provides for the bypass or backpass of sand that is captured.

An IDNR permit is required for any shore protection that involves building a beach. This requirement includes the filling of the beach to the maximum capacity of computed sand retention, and, in addition

to this capacity volume, including a 20 percent overflow. This overflow assures sand is available, if needed for any unforeseen adjustment to the beach and nearshore profile. The IDNR distributes public notices for any permit applications, allowing public review for proposed project plans. There is a 30-day period for written comments, and no work can begin until the permit is issued.

The wide range of historical lake-level fluctuation, (6.3 feet; see Chapter 2), results in a need for shore protection that has direct interaction with lake water only during times of extremely high lake levels. An example is the revetments built at the toe of the bluffs. Although these revetments may have some wave impact during extreme storms, commonly a beach may exist adjacent to the revetment. Only at times of higher lake levels might the still water be in contact with the structure.

Permits are required for shore-protection structures for both private, and public, lakeshore property to be built extending onto the lake bottom. This is despite the lake bottom being state land held in public trust. Filling of lakeshore land is conditionally permitted by Illinois state law as long as the filling serves a public benefit. An example is the creation of the parkland along the Chicago lakefront.

Both the IDNR and the USACE, Chicago District, permit lakeshore construction to the Ordinary High Water Mark (OHWM). This is the typical or “ordinary” high level to which the lake water will rise in long-term fluctuation. Most often, the lake level is below this elevation.

In some coastal states, the OHWM defines the boundary between private property and public beach. In Illinois, private property and riparian rights along the Illinois coast extend to the calm water shoreline and migrate landward or lakeward with changing lake level (Illinois case law: *Brundage v. Knox*, 1917).

As defined by the USACE, the OHWM along the Illinois coast is 581.5 feet (177.2 m) relative to the International Great Lakes Datum (IGLD-85). Only shore construction that occurs below this elevation is subject to permitting by the IDNR and the USACE.

Permitting Projects for Coastal Erosion Control - *Specifics*

Both private and public construction activities in Lake Michigan require Illinois Department of Natural Resources, Office of Water Resources’ (IDNR/OWR) authorization, pursuant to the “Rivers, Lakes and Streams Act of 1911” (615 ILCS 5) and IDNR/OWR (Part 3704) “Regulation of Public Waters”. Both the IDNR/OWR and the USACE use the ordinary high water elevation, 581.5 ft. International Great Lakes Datum-1985 (IGLD-85) to determine whether a permit is required. Construction activities proposed at or lakeward of that elevation require IDNR/OWR authorization. IDNR/OWR permits are issued jointly with the Illinois Environmental Protection Agency (IEPA). The following two types of shore protection permits are issued for work in Lake Michigan:

- General Permits No. 1-LM are issued for minor shore parallel protection projects that do not exceed a length of 300 ft., and which meet the special conditions of that general permit. Examples of these

projects would be stone revetments or steel sheet pile bulkheads built at the toe of a bluff. This permit does not require the issuance of a public notice but does require IEPA approval.

- All other types of shore protection projects proposed, within or adjacent to, and below an elevation of 581.5 IGLD-85 require a regular permit from IDNR. Examples of these types of projects include but are not limited to, revetments (longer than 300 ft.), seawalls or bulkheads (longer than 300 ft.), groins, breakwaters/offshore structures, beach nourishment, piers, and modifications to existing structures. These types of projects require the issuance of a 28-day public notice. These projects are reviewed by IDNR/OWR for compliance with Part 3704 Rules, and also require IEPA approval prior to a permit being issued.

Projects proposed outside the waters or the influence of Lake Michigan coastal processes, and which are entirely above the Department's regulatory elevation of 581.5 (IGLD-85), do not require a permit. These include projects on a bluff, and areas upslope or landward of the existing bluff toe or bluff toe protecting structure. Projects on bluffs or otherwise outside IDNR jurisdiction may still be within the ICMP boundary, and thus must be in accordance with ICMP enforceable policies. If a proposed activity would degrade water quality of Lake Michigan it would require a permit. Maintenance work associated with the restoration of an existing permitted project to its original specifications does not require a new permit.

As previously noted, IDNR/OWR personnel must determine whether a proposed shore protection project complies with the Department's Part 3704 Rules. Section 3704.70 specifically prohibits the conversion of public waters to private land by filling; however, fill material may be placed in public waters for such things as bank, shore or bluff protection, and beach nourishment. Section 3704.80(a) specifies that the proposed activity must not: 1) cause an obstruction to, or interfere with, the navigability of a public body of water, 2) result in an encroachment on a public body of water, 3) cause impairment of any rights, interests or uses of the public in any public body of water or to its natural resources, or 4) cause bank or shoreline instability on other properties.

Section 3704(b) outlines additional information an applicant should submit if the proposed activity might cause one or more of these impacts. Section 3704.90 contains the standards IDNR uses to determine whether a permit should be issued. Generally, proposed offshore structures should be located as close as possible to the shore and be no larger than needed to protect the applicant's property. The size of the structure including height, length, etc. should be comparable to adjoining structures in the area. Where possible, the project should provide some type of reasonable access over or around it on the landward side.

Upon receipt of an application, an initial review will determine the need for clarification, or additional information, if any. At the same time, the applications are forwarded to the IDNR, Office of Realty and Environmental Planning for their review. The applicant is responsible for contacting the Illinois Historic

Preservation Agency for any requirements they may have. If the initial review determines that a project will not require a permit, the Department will inform the applicant by letter.

If a project requires a Regular Permit, a public notice will be issued. For shore protection projects, the minimum public notice period will be 28 days. This public notice period may be extended if needed to allow interested parties the opportunity to prepare and submit comments.

Once the Department has received all the required information including public notice comments and responses, it will determine whether the proposed project is in compliance with the provisions of our Part 3704 Rules. If the project is found to be in compliance with these rules, an IDNR/OWR Permit will be issued. If it is found not to be in compliance with the Part 3704 Rules, a denial letter will be issued. All denials are issued without prejudice and include a detailed explanation.

ICMP Coastal Erosion Assessment and Planning

- Assessment

The vast majority of the Lake Michigan coastline in Illinois is protected from erosion by hardened structures. IDNR estimates that upwards of 85 percent is protected, and that much of this work was financed privately, specifically in the areas outside of public areas. In assessing coastal erosion issues, the ICMP reviews aerial photography that is conducted at three year intervals combined with visual inspections of areas not currently protected by hardened structures. Illinois Beach State Park represents approximately 95 percent of the area that is not currently protected by hardened structures.

- Planning

When the IDNR erosion assessment process identifies a coastal erosion problem, the next step is to engage stakeholders and develop a management plan that incorporates several key perspectives regarding coastal processes along the Illinois coast. These are:

The Illinois coast was nearly all erosional in its pre-development setting. The exception was the southern end of the Zion beach-ridge plain. Human activity has been responsible, in places and at times, to focus and exacerbate erosion. However, the human erosional influence is additional to naturally occurring erosion.

Waves are the dominant agent of Illinois coastal change. Fluctuating lake levels, changing sediment budgets, and ice dynamics all contribute to change. However, waves provide the energy to move sediment and ice and cause the impact energy against shore structures.

Lake-level change is a continuous and natural process with various times scales (hourly, daily, monthly, seasonally, yearly, decadal and geologic). Erosion planning needs to include consideration of future lake-level change while also recognizing the uncertainty in long-term lake level prediction.

Waves are the agent for moving sediment along the Illinois coast. Sediment can be moved northward by waves from the southeast quadrant or southward by waves from the northeast quadrant. Because of the greater fetch for northerly waves, these produce the net and regional littoral transport which is from north to south.

The Illinois coast has experienced reduction in the volume of littoral sand in transport during historical time. This is a result of both reduced sediment input from shore and bluff erosion and structural blockage and entrapment of littoral sand. Conservation of existing sand resources is critical.

The Illinois coast is what is geo-technically called a “cohesive coast.” This means the upland to nearshore profile primarily consists of cohesive materials (glacial till). Any sand or gravel along the beaches and nearshore are a lens or veneer superimposed on the cohesive material. Erosion of the cohesive materials is non-reversible.

Areas of greatest concern for coastal erosion will change with time, and the ICMP efforts toward erosion management will adjust accordingly. For example, in the 1970s, most of the bluff coast was a critical erosion area, and during the record high lake levels of 1986-1987 erosion of beaches, parkland and deteriorated shore protection was a major concern along the Chicago lakefront.

Although localized erosion “hot spots” may intermittently come to the forefront, the ICMP will maintain a continuing focus on two erosion areas of critical concern. These will have a priority for erosion mitigation and long-term management.

- Illinois Beach State Park: This park lakeshore is dependent on an adequate supply and transport of littoral sand to maintain a balanced sediment budget. The most severe erosion is presently in the North Unit, but the potential for severe erosion exists along all of the state park shore if a littoral sediment supply is deprived. A management plan for Long Term Coastal Stewardship of Illinois Beach State Park and North Point Marina was completed in 2001. The ICMP will not fund beach nourishment, but the ICMP will prioritize other ways that are ICMP compliant to assist IDNR erosion monitoring and management.
- Nearshore Lakebed: Depletion of sand cover across the nearshore lake bottom, and erosion of the glacial till lakebed will be a sustained management concern. Evaluation and monitoring of this erosion will be promoted and supported. This is an erosion process that has implications for permanent change to the morphology of the Illinois coast.

The ICMP coastal erosion management will involve partnerships with appropriate municipal, county and state agencies concerned with coastal erosion along the different segments of the Illinois coast. Partnerships will also be developed with governmental agencies having responsibility for erosion management along the inland waterways.