2.10 COASTAL EROSION

The 1998 Coastal Erosions Area maps defined Coastal erosion is defined as the gradual wearing away of the earth's surface by the natural forces of wind and water. The constant action of wind, waves, and ice flow has affected the coastline of Lake Erie. Primarily, the waves and gravity cause erosion. Waves undercut the land along the shore and gravity causes the land to slip into the water. As material from the bluff or bank slides into the lake, it too is eroded by waves. As this process continues, the shore moves farther landward. Many natural factors affect erosion of the lakeshore, including shore and nearshore geology, shore relief, nearshore bathymetry, beaches, shoreline orientation, lake level fluctuations (long-term, annual, and storm surges), and climate changes (storm frequency, temperature, and precipitation).

The History of Lake Erie by Michael C. Hansen notes Lake Erie owes its fundamental existence to the presence of a basin or lowland that originated long before the Pleistocene Ice Age began 2 million years ago. This lowland was known as the valley of an east-flowing river, known as the Erigan River. This geology in the basin included Silurian and Devonian carbonates (limestone and dolomite) on the west and by Devonian shales on the east. Glacial ice was able to erode the less resistant shales (than the more resistant carbonate rocks) to a greater extent in the central basin and eastern basins. The first of the four major glacial advances during the Pleistocene obliterated this drainage system, and deepened and enlarged the basin. Succeeding glaciations further deepened and enlarged it. Lake Erie, the southernmost of the Great Lakes, is also the shallowest because the ice was relatively thin (therefore lacking significant erosive power) when it reached so far south. During the advancement of the glaciers, they eroded rock and soil and carried them with the flowing ice to the glacier edge where they were deposited as till released from melting ice. Laminated silt and clay were also deposited in proglacial lakes that formed along the margin of the glacier. These geologic materials are exposed in Lake Erie's bluffs and banks. Upon final retreat of the glacier moving out of Ohio, the water started to discharge via the Niagara River. Glacial rebound raised the Niagara outlet and increased the water level in the Lake Erie basin. Due to a rapid glacial rebound in the upper Great Lakes, these lakes began to drain through the Lake Erie Basin 6. There has been a continued slow rise following the rapid rise that has brought Lake Erie to its current mean level of 571 feet above sea level.

Per the Geologic Setting and Processes Along Lake Erie From Fairport Harbor to Marblehead, the geologic settings vary throughout the length of Ohio's coast. From the Ohio- Pennsylvania border to Huron, Ohio, moderate to high relief shore consists of bluffs and slopes composed of glaciolacustrine sands, silts, clay, till, and/or shale. From Huron around Sandusky Bay to Marblehead peninsula, the shore is a low relief plain composed of glaciolacustrine sediments and till, with shale exposed west of Huron and limestone exposed around Marblehead peninsula. At Sandusky Bay, two barrier beach complexes extend across the bay mouth. Around Marblehead Peninsula and Catawba Island, low to moderate banks/bluffs are composed of rock and till. West of Catawba Island, the landscape consists of low-relief lake plain and coastal wetlands (remnants of the Black Swamp). Nearshore slopes are generally gentle and are composed of the same materials in bluff or bank. Beaches are typically narrow (<50 feet per 15 meters wide) to non-existent along much of the shore. Manmade features have affected the longshore transport of sand trapping sand on the updrift side at harbor jetties, power plant intakes, and long groins. Shore parallel structures have altered sand transport as well.

Climate affects overall physical setting in the nearshore, beach, and shore zones. Long-term and annual fluctuations in lake level are due to changes in the volume of the lake resulting from changes in precipitation in the Great Lakes Basin. Short-term fluctuations are due to wind-driven storm surges, changes in barometric pressure, or inertial surges of water (seiches) that occur after lake level has been set up by either of the two previous agents. The greatest storm surges occur when the wind

blows parallel to the long axis of the lake. Under extreme conditions, lake level at the confined ends of the lake may rise or fall more than six feet from pre-storm levels. Passage of storm systems through the Great Lakes can cause lake levels at the ends of the lake to fluctuate 10 to 11 feet over a period of several days. The most important storm surges along the western part of the Central Basin and all of the Western Basin are those generated by northeast winds because these storm surges are accompanied by large storm waves.

The size of wind-generated waves depends upon wind speed and duration, open-water fetch distance, and water depth. The largest waves affecting the Ohio lakeshore are those generated by storm winds from the west through the northeast. Wave energy is highest from late fall through spring; however, lake level is at its lowest and shorefast ice typically forms a barrier between the waves and erodible shore material. Most wave erosion occurs during storms in early spring when the greatest amount of wave energy is expended on the shore. The largest waves to strike the shore are generated by onshore storms winds from the west to the northeast. Wave erosion causes undercutting of the bluff or bank, mass wasting including block falls, rotational slumps, and debris flows, and lakebed down cutting of cohesive materials. Bedrock is not as easily eroded as the cohesive glacial sediments. Although erosion of the bluff is necessary to sustain beaches, excessive erosion of the Lake Erie shoreline can be considered a hazard exposure.

Coastal Erosion Area

A Coastal Erosion Area (CEA) is a designated area of land adjacent to Lake Erie that is anticipated to be lost to erosion in 30 years unless preventive measures are taken. Coastal erosion is measured by determining how far landward the bluff, bank, or dune has receded over time. The landward shift of the bluff, bank, or dune is called recession.

Coastal erosion area designations are a component of the Ohio Coastal Management Law passed by the Ohio Legislature in 1988 in response to the serious hazards and substantial economic losses caused by coastal erosion. The laws and rules that define the Coastal Erosion Area program are found in Ohio Revised Code Section 1506 and Ohio Administrative Code Section 1501-6. The objective of the CEA program is to identify the hazards and mitigate the economic losses of erosion-related damage.

The Ohio Department of Natural Resources (ODNR) developed standards for designating coastal erosion areas with input from geologists, engineers, local officials and landowners. CEAs are depicted on maps that are produced by ODNR. To develop coastal erosion maps, rates of recession are calculated using analytical tools, including aerial imagery and LiDAR, mathematical calculations and field visits to verify observations. The amount of recession that is calculated is used to project recession rates for a 30-year period; areas that are projected to erode greater than a given threshold amount are designated as CEAs and shown on coastal erosion maps. The maps include data tables that show the amount of recession calculated at regular 100-foot intervals along all of Ohio's Lake Erie coast, including the bays and islands.

ODNR has mapped Ohio's Lake Erie coast to identify coastal erosion areas since 1988. Maps showing the first CEA designations were finalized in 1998 and were based on the amount of recession that occurred between 1973 and 1990. Since then, ODNR has updated CEA designations in accordance with the laws and rules that define the CEA program. In 2010, ODNR released maps based on the amount of recession that occurred between 1990 and 2004. The 1998 and 2010 CEA maps now serve only as historical records.

In January 2019, ODNR released the 2018 CEA maps, which depict the most current CEA designations based on the amount of recession that occurred between 2004 and 2015. ODNR uses these maps to determine if

a property is currently located within a CEA. All sets of CEA maps are available to view online at https://gis.ohiodnr.gov/MapViewer/?config=cea.

Property along Ohio's Lake Erie coast that is located within a designated CEA is subject to CEA program requirements, which address property sales and transfers and construction. Landowners selling or transferring property within a designated CEA must disclose that status on the Residential Property Disclosure Form, which is required with all residential real property transactions in Ohio. Construction within a CEA may require a CEA Permit, depending on the type and location of a structure. A permit is required to construct a new building or add 500 square feet or more (as measured at ground level) to an existing structure. This applies to residential, commercial, industrial, institutional and agricultural buildings, and septic systems. CEA Permits are issued by ODNR through the Office of Coastal Management.

RISK ASSESSMENT

LOCATION AND SELECT HISTORICAL OCCURRENCE

Lake Erie comprises 312 miles of the northern coast of Ohio bordering Lucas, Ottawa, Sandusky (Sandusky Bay), Erie, Lorain, Cuyahoga, Lake, and Ashtabula Counties. Lake Erie, the 12th largest (area) lake in the world, is about 210 miles long, 57 miles wide, and has a shoreline length of 871 miles (including the islands). With the exclusion of government-owned park and reserve areas, the coast is highly prized for commercial and residential development. In many cases, human activity has disrupted the natural function of beach formation and aquatic habitats. According to the Ohio Geological Survey, 95 percent of Ohio's Lake Erie shoreline is eroding.

Unlike many of the other hazards affecting Ohio, Lake Erie is consistently undergoing coastal erosion. Although particular storms or development creates periods of increased occurrence, the shore is eroding slowly every day. To monitor erosion, the net landward movement of the shore over a specific time is calculated. The position of characteristic shore features such as bluff lines can be determined from maps and aerial photographs. By analyzing the position of these features (recession lines) through time, the amount of recession can be determined and rates of recession can be calculated. Long-term and short-term recession data have been developed for each county (see table 2.10.a).

Table 2.10.a – Ohio Lake Erie Erosion Statistics by County from 2004 to 2015

County	Distance	Feet/year
Ashtabula	2.8	0.26
Lake	5.4	0.49
Cuyahoga	0.8	0.07
Lorain	0.3	0.02
Erie (lake)	0.3	0.03
Ottawa (lake)	0.5	0.04
Lucas	0.2	0.01
Erie (bay)	0.6	0.05
Ottawa (bay)	9.1	0.54

During 1929-30, the mid-1940s, 1952, the fall of 1972, the spring of 1973, and 1985, 1998 and 2012 storms and high lake levels caused property damage along the low-lying areas, such as low glacial till bluffs, low glaciolacustrine banks, and barrier beaches and eroded high glacial till or glaciolacustrine bluffs inducing mass wasting in Erie, Lake, Cuyahoga, and Ashtabula counties. The short-term and long-term rates indicate that the low-lying areas have been extremely affected.

LHMP DATA

All of the LHMPs for the counties that border Lake Erie (Ashtabula, Cuyahoga, Erie, Lake, Lorain, Lucas, Ottawa, and Sandusky), indicate that coastal erosion is a recognized hazard and ranked them either fourth or fifth for their county. Almost all of the plans reference the same data (Figure 2.10.a) provided by the Ohio Geological Survey. Erie County's LHMP indicated that they had completed a structural inventory in the late 1990's; but those data were not available to them at the time of writing their plan.

Ashtabula County. The HIRA of the Ashtabula County Countywide All Natural Hazards Mitigation Plan of August 2012 describes that 28 miles of Lake Erie coastline form the northern border of the County. The HIRA also explains that factors such as high lake levels, long shore currents, high winds, water runoff over cliffs, bluff recession and seasonal fluctuations are driving forces that lead to coastal erosion. The risk is classified as a Moderate Probability and Moderate Impact. The plan's vulnerability analysis determined 2,619 structures would be affected with a loss estimate of $78,295,582.

Lake County. As part of the Lake County Planning Commission's coastal management plan, breakwalls have been constructed in Mentor and North Perry. Further, individual jurisdictions have been compiling agreements with appropriate contractors, state agencies, and local partners to ensure that response measures (such as shoring up structures and filling in eroded areas) can be implemented quickly. These jurisdictions include Fairport Harbor, Painesville Township, and North Perry. While coastal erosion is likely to remain a hazard for the foreseeable future (due to the county's proximity to Lake Erie), potential losses have been lessened since previous adoptions of this plan.

Erie County. Factors that cause shoreline erosion include bluff recession, high lake levels, high winds and human activities. These cause many problems to the coastal communities of Bay View, Sandusky, Huron, Vermilion and Kelley's Island. Manmade shoreline structures that lie within a designated CEA along Lake Erie's coastline are susceptible to property damage over a 30-year period. Because of the large number of residential properties located within a CEA along the shoreline, property damages are expected to be high.

Based on the property damage expected from stream bank and lake erosion, the impact on the local economy and local government expenditures is considered to be high. Manmade shoreline structures built along the Lake Erie shoreline, trap sand supply, causing beachless shores. Lack of beaches may have an adverse effect upon tourism in Erie County. County roadways may be affected and in need of repair, but this repair does not typically have an adverse effect on the economy, as motorists will find an alternate route.

Lucas County. According to the Lucas County Countywide All Natural Hazards Mitigation Plan of March 2013, lake surges (also referred to as storm surges) are associated with extreme weather events and are responsible for coastal flooding and erosion along Lake Erie within Lucas County. The storms that generate the large waves of lake surges can develop year-round, however within Lucas County, these events have typically occurred in the early spring and late fall months. Storm surges inundate coastal floodplains, the rise in water levels in inland bays and harbors, and backwater flooding through river

mouths. Coastal erosion is generally associated with storm surges, windstorms, and flooding hazards, and may be exacerbated by human activities such as boat wakes, shoreline hardening, and dredging. Conversely, actions to supplement natural coastal processes, such as beach nourishment, dune stabilization, and construction of shore protection structures can greatly modify and reduce erosion trends within an area.

Ottawa County. Within Ottawa County, the risk for coastal erosion varies by jurisdiction. The lakeshore jurisdictions in the western portion of the county have a higher coastal erosion risk than those to the east. The coastal areas in Carroll, Erie, and Bay Township are primarily beach and marsh areas with low elevations. Structures in these coastal areas are primarily residential, and include a large percentage of summer homes and seasonal cottages. Some of these areas are protected by break walls that reduce the impact of waves as they wash onshore.

The eastern municipalities of Marblehead, Port Clinton and Put-In-Bay and Catawba Island, Danbury, Portage, and Put-In-Bay Townships are susceptible to coastal erosion but, given their high elevation and rocky surface and sub-surface, erosion is less likely to impact structures than in other areas of the county. The high cliffs and rock ledges protect the homes, businesses, and infrastructure along the lakeshore from wind and water damage. In the city of Port Clinton, the highway and homes are several hundred feet from the coastline and not significantly susceptible to coastal erosion damage. While the county is significantly lakefront, there is not a large amount of beach across the shoreline. A large percentage of the coastal area is either marsh and wetland, or rocky ledge.

SHARPP. See Section 4.3 for an analysis of coastal erosion data in local hazard mitigation plans.

Coastal Barrier Resourse System

The Coastal Barrier Resources Act (CBRA) of 1982 and subsequent amendments established the John H. Chafee Coastal Barrier Resources System (CBRS). The CBRS consists of relatively undeveloped coastal barriers and other areas located the Atlantic, Gulf of Mexico, Great Lakes, U.S. Virgin Islands, and Puerto Rico coasts. The CBRS currently includes 585 System Units, which comprise nearly 1.4 million acres of land and associated aquatic habitat. There are also 277 "Otherwise Protected Areas," a category of coastal barriers that are mostly already held for conservation and/or recreation purposes that include an additional 2.1 million acres of land and associated aquatic habitat. The CBRS units are identified and depicted on a series of maps entitled “John H. Chafee Coastal Barrier Resources System.” These maps are controlling and indicate which lands are affected by the CBRA. The maps are maintained by the Department of the Interior through the U.S. Fish and Wildlife Service and can be viewed at: https://www.fws.gov/cbra/Maps/Mapper.html.The Coastal Barrier Resources Act and its amendments prohibit most new federal expenditures that tend to encourage development or modification of coastal barriers. The laws do not restrict activities carried out with private or other non-federal funds and only apply to the areas that are within the defined CBRS. The main prohibition affecting property owners is the prohibition on federal flood insurance.

Examples of prohibited federal assistance within System units include subsidies for road construction, channel dredging, and other coastal engineering projects. Federal flood insurance through the National Flood Insurance Program is available in a CBRS unit if the subject building was constructed (or permitted and under construction) before the CBRS unit's effective date. If an existing insured structure is substantially improved or damaged, the federal flood insurance policy will not be renewed.

PROBABILITY OF FUTURE EVENTS

With shore structures increasing along the coastline, the shoreline becomes increasingly modified. Reports and studies suggest that wave erosion and mass wasting caused by Lake Erie will continue to erode the Ohio shore for the foreseeable future. Damage to the built environment is inevitable without intervention and will warrant the full understanding of coastal processes within each stretch to rehabilitate the shoreline.

STATE-OWNED AND STATE-LEASED CRITICAL FACILITIES VULNERABILITY ANALYSIS & LOSS ESTIMATION

Previous versions of this plan indicated that coastal erosion had limited potential to affect any state-owned structures or critical facilities. All state facilities near the Lake Erie Coast were evaluated for their proximity to coastal erosion areas using the DAS data within a GIS. No state-owned or state-leased facilities were located in the coastal erosion areas, which represents no change since the last plan update.