

Lake Erie Shore Erosion Management Plan

Cedar Point to Vermilion - Reach 02



About the Program

In an on-going effort to assist property owners along Ohio's Lake Erie coast by providing free technical assistance, the *Lake Erie Shore Erosion Management Plan (LESEMP)* is being developed by the Ohio Department of Natural Resources through a partnership between the Office of Coastal Management, Division of Wildlife and Division of Geological Survey.

The *LESEMP* identifies the causes of erosion in specific areas called reaches which are stretches of shore with similar site conditions. The *LESEMP* then outlines the most likely means of successful erosion control based on reach-specific erosion issues, geology and habitat. The objective of the reach-based approach to erosion control is to simplify the decision process while enhancing the effectiveness of solutions to erosion related issues.

The *LESEMP* does not contain any regulatory oversight provisions.

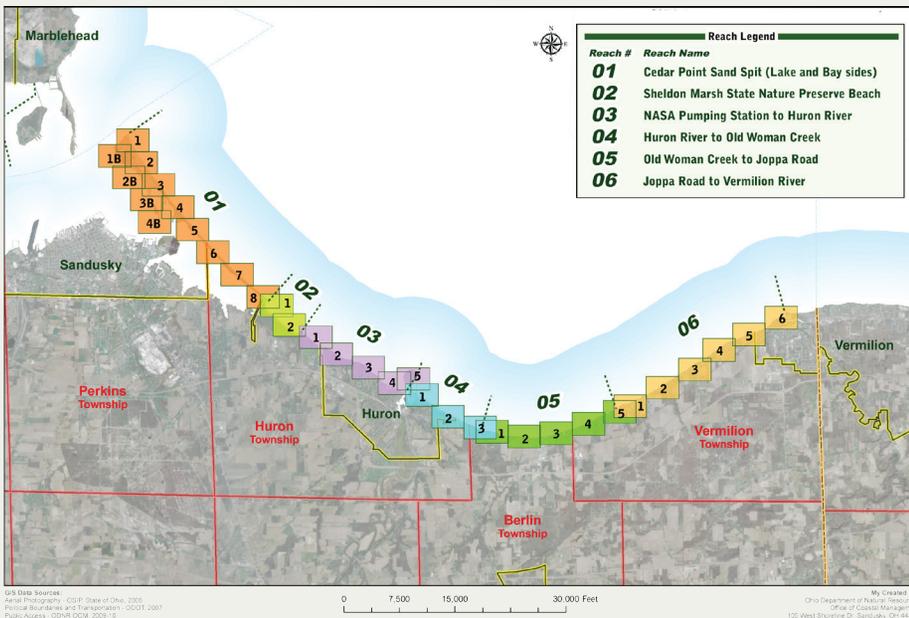
Description

Reach 2 of the Cedar Point to Vermilion Region extends from the east end of the Cedar Point sand spit to the NASA Pumping Station in Huron Township. This reach includes approximately 7,300 feet of barrier beach at Sheldon Marsh State Nature Preserve which separates the open waters of Lake Erie to the north from the coastal wetlands at Sheldon Marsh to the south.

The barrier beach at Sheldon Marsh is generally oriented from northwest to southeast. The beach originally formed the base of the Cedar Point sand spit and was continuous from Cedar Point Road to the NASA Pumping Station. The current beach is set between the armored headlands at the Point Retreat Condominiums to the northwest and the NASA Pumping Station to the southeast. The hardening of the shore at the ends of the beach and a reduction of sand supply to the area has resulted in significant erosion and overall recession of the barrier beach. The beach has recessed enough to form a considerable embayment in the shore. The resulting embayment, isolated from the surrounding area by headlands, has developed into a separate littoral system.

At the west end of the reach is a small channel between the barrier beach at Sheldon Marsh and the Point Retreat Condominiums. This channel provides access for the boat slips along Point Retreat and a connection between the east end of Sandusky Bay and Lake Erie. The large revetment at the tip of Point Retreat also provides some protection to the northwest end of the barrier beach at Sheldon Marsh. The curved end of the beach begins immediately south of the channel and about 400 feet from the end of Point Retreat and extends to the southeast. This area of barrier beach has a significant history of breaching during severe storms or cycles of high water.

The slightly curved center portion of the beach extends approximately 4,000 feet before bending to the northeast toward the NASA Pumping Station. The shore at the pumping station is protected with armor stone on the southwest side (facing the beach). This portion of the structure was added as the barrier beach receded. The northwest side is protected with a steel sheet pile seawall capped with concrete. The northeast and east sides of the pumping station are protected with a cast-in-place concrete seawall



The LESEMP is being developed by the project partners, Ohio Department of Natural Resources Office of Coastal Management, Division of Geological Survey and Division of Wildlife. Federal grant funding for this project is provided by the National Oceanic and Atmospheric Administration.

with concrete blocks and armor stone as toe protection. The structures were originally constructed in 1941. At the time of construction the structures were along the shore but are now on an exposed peninsula as the unarmored surrounding areas have receded.

Nearshore slopes in this reach range from about 1 degree for the first 100 feet to about 0.5 degrees farther offshore. The nearshore is mostly comprised of thick sand deposits but littoral processes occasionally uncover underlying glaciolacustrine clay or peat deposits. The nearshore at Sheldon Marsh is characterized by a submerged portion of Cedar Point Road extending between the Point Retreat Condominiums and the NASA Pumping Station. The road was flooded and submerged as the shoreline at Sheldon Marsh receded. Moderately defined sand bars occasionally form in the shallow water within the first 100 to 200 feet from shore.

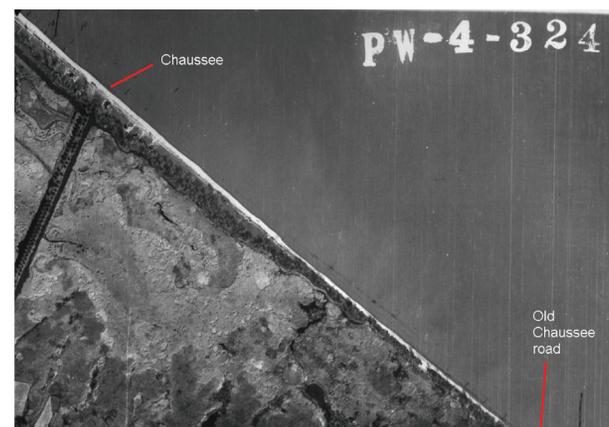
The net direction of littoral currents in this area is from southeast to northwest. Longshore transport of littoral material into or out of the embayment is generally prevented by the headland structures at the ends of the beach. In embayments isolated by headlands sand is often lost from the system due to littoral transport from the ends of the beach to the center then offshore. Littoral material can also be washed into the marsh by wind or waves during severe storms.

Recession/Erosion

The ODNR Division of Geological Survey has evaluated the recession of Ohio's Lake Erie shore over three time periods: 1877 to 1973, 1973 to 1990 and 1990 to 2004. Changes in the rates measured during each of the time periods are generally attributed to development along the coast and natural factors such as lake level changes.

Due to the variability of the Cedar Point sand spit before development and the lack of similar geographic features (such as roads or permanent structures) to align the images, the 1877 maps can not be accurately compared to more recent aerial photographs. As a result aerial photographs from 1937 are the earliest data available to determine historic recession for this reach.

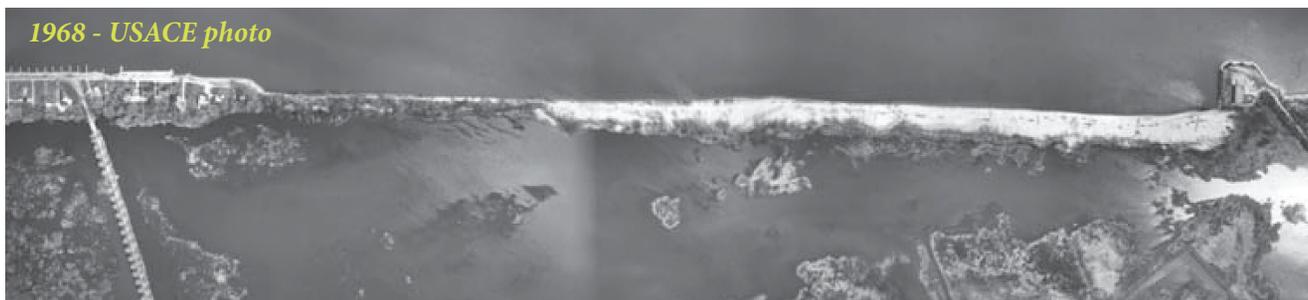
In 1937 the shore consisted of a long consistent beach separating the coastal marshes and low lake plains from Lake Erie. In 1941 the NASA Pumping



An aerial view of Sheldon Marsh State Nature Preserve on Oct. 10, 2010, shows the large embayment that has formed since 1937 between the present day Point Retreat Condominiums (PRC) and the NASA Pumping Station (NPS). The open waters of Lake Erie are to the right of the picture. The white line represent the approximate location of the 1937 shore as seen in the top right aerial image by the USACE; the red lines in it mark the approximate location of the PRC and the NPS.

Station was constructed. During the time period from 1937 to 1973 the shore experienced rapid recession and occasional breaching. Recession rates from 1937 to 1973 ranged from 7 to 11 feet per year.

By 1973 the barrier beach had recessed about 350 feet at the base of the NASA Pumping Station and was significantly breached at the west end. Although the large breach in the barrier beach was filled, the rapid recession continued from 1973 to 1990 with average recession rates ranging from 15.8 feet per year at the base of the NASA Pumping Station to 56.3 feet per year near the center of the beach.



From 1990 to 2004 recession rates ranged from 0 feet per year to 45.8 feet per year. Overall recession rates were significantly reduced due to lower water levels and the stabilization of the beach due to the formation of the headland-bay beach system. Some areas of the beach experienced minor accretion as the beach was smoothed to its current embayed form. Recession was greatest near the northwest end of the beach.

Additionally, the Army Corps of Engineers has also studied recession at Sheldon Marsh. They found that from 1937 to 1997, the barrier beach experienced 1,175 feet of recession, averaged at five points of measurement, for an average recession rate of 18.0 feet per year. From 1997 thru 2003, USACE noted that the beach remained fairly stable. The majority of the recession is correlated with the high lake levels and storm events in the early 1970's late 1980's and in 1997.

Flooding

This reach is a narrow barrier beach between Lake Erie and the east end of Sandusky Bay. The low lying marshes and barrier beach are susceptible to flooding as well as erosion. Floods have usually been associated with gales from the northeast, such as may occur when tropical storms or the remnants of hurricanes migrate to the northeastern U.S. and southeastern Canada. The resulting winds, rotating counterclockwise around the storm center, may blow over many miles of open lake, piling water in the western basin and leading to overtopping or breaching of the barrier beach in this area. If the storm coincides with a period of high water, the effect is intensified. The barrier beach in this area has a history of breaching during periods of high lake level, making the area especially vulnerable to flooding.

Beaches/Sand Supply

A barrier beach fronts the entire reach from the east end of the Cedar Point sand spit to the NASA Pumping Station. The beach has a history of significant erosion. The recession of the barrier beach at Sheldon Marsh is intensified by the overall lack of sediment flow into the beach. Sediment transport into this area is likely hindered by the navigation structures at the mouth of the Huron River approximately 3 miles up-drift and is further reduced by the NASA Pumping Station immediately up-drift.

The embayed shape of the current beach and the structures at both the NASA Pumping Station and the Point Retreat Condominiums help prevent material from being transported alongshore from the beach at Sheldon Marsh. Sand is still lost from the system due to cross shore transport (offshore) or washing into the marsh (onshore).

Use of Shore Structures

The beach at the Sheldon Marsh State Nature Preserve is completely unarmored. The NASA Pumping Station at the east end of the reach is protected with a variety of seawalls and revetments. These structures, along with the revetment at the Point Retreat Condominiums have contributed to the formation of the embayment in this reach.

Habitat

Sheldon Marsh State Nature Preserve is one of the few remaining natural coastal wetlands in Ohio. The preserve provides a variety of habitats

including nearshore, barrier beach, cattail marsh, woodland swamp, hardwood forest and old field. The preserve provides habitat for nearly 300 species of resident or migratory birds including warblers, waterfowl, shorebirds, wading birds, owls and raptors. The preserve also provides habitat for several state and federal endangered species including the tiger beetle, piping plover, small-flowered evening primrose and Engleman's spike rush. Erosion of the barrier beach could permanently alter these habitats. Erosion management is a consideration for the preservation and restoration of the nature preserve.

Summary

The reach from the east end of Cedar Point Road to the NASA Pumping Station contains a barrier beach fronting the Sheldon Marsh State Nature Preserve. The barrier beach has a history of rapid erosion and breaching. The current beach has recessed enough to form an embayment between the artificial headlands created by the revetments at the Point Retreat Condominiums and at the NASA Pumping Station. The headlands surrounding the beach help prevent the transport of littoral material into or out of the embayment. The formation of the isolated beach embayment, along with periods of lower water levels, has helped decrease recent erosion rates. The lack of sediment supply to sustain the barrier beach makes the area susceptible to future erosion and breaching. As one of the few remaining natural coastal wetlands in Ohio, habitat preservation and restoration is a critical consideration in any erosion management plan.

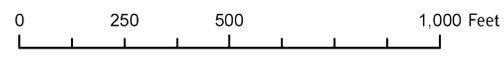


Vegetation grows at the back of the beach in the September 24, 2010 photo (left) and August 10, 2010 photo (middle). The wetland marsh is shown in the August 14, 2009 photo (right). The treeline in the distance is along the south side of the barrier beach.



Sheldon
Marsh SNP

GIS Data Sources:
 Aerial Photography - OSIP, State of Ohio, 2006
 Political Boundaries and Transportation - ODOT, 2007
 Public Access - ODNR OCM, 2009-10



Created By:
 Ohio Department of Natural Resources
 Office of Coastal Management
 105 West Shoreline Dr, Sandusky, OH 44870



Sheldon
Marsh SNP

NASA Pumping Station

CV 02
CV 03

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Political Boundaries and Transportation - ODOT, 2007
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0 250 500 1,000 Feet

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Recommendations

Erosion at Sheldon Marsh has been extensively studied by the U.S. Army Corps of Engineers and the Ohio Department of Natural Resources. In order to better manage erosion and help prevent future breaching of the barrier beach, a wide variety of potential alternatives have been proposed for work under Sections 227 and 1135 of the Water Resources Development Act of 1986. These alternatives include: beach nourishment, dune construction, submerged breakwaters in the nearshore, artificial headland breakwaters, and a terminal groin along the channel at the west end of the barrier beach. The preferred alternative will likely be a combination of the alternatives and will be constructed as a joint project between the Ohio Department of Natural Resources and the U.S. Army Corps of Engineers.

The recommendations included below are a summary of the options proposed by the U.S. Army Corps of Engineers and the Ohio Department of Natural Resources, as well as additional recommendations that may be applicable within this reach. Each recommendation includes a brief overview of the solution prior to addressing areas within the reach where the recommendation is best suited. For more information on any of the items listed below, please refer to the Glossary and Appendix: Erosion Control Solutions.

In addition to the recommendations listed below, a “do nothing” alternative should also be considered. The probable impacts of not taking action should be carefully considered when planning any erosion management project. A no action alternative is a viable, and even favorable, alternative for much of Ohio’s Lake Erie shore. In areas with low erosion rates or where the shore

is protected with effective structures additional protection might not be necessary. In these areas attention should be focused on monitoring the site conditions and maintaining current structures.

In a dynamic barrier beach area such as Sheldon Marsh the natural processes of sand migration and occasional breaching also must be considered. A barrier beach naturally experiences periodic breaching during high water cycles. Occasional breaching provides a connection between the coastal marsh and the lake and may even be necessary for the long-term sustainability of the marsh. With adequate sand supply the breaches close during periods of low water. The dynamic barrier beach system at Sheldon Marsh warrants close monitoring and further study. While recent recession rates at Sheldon Marsh have decreased, not taking action may result in



January 12, 2012: From the paved walking path, the boardwalk meanders through the wetlands onto the beach which is visible through the trees (top). The 180-degree bottom photo was taken standing at the southeastern portion of Sheldon Marsh State Nature Preserve’s barrier beach where the boardwalk exists onto the shore. On the right side of the photo, the NASA Pump Station is visible through the trees. A narrow strip of ice is also present along the shore at the right of the bottom photo.

future migration and frequent breaching of the barrier beach. For this reason, and to preserve the natural coastal wetland habitat, the U.S. Army Corps of Engineers and the Ohio Department of Natural Resources are considering Sheldon Marsh for a joint restoration and preservation project.

Due to the sensitive barrier beach and coastal wetland system at Sheldon Marsh there are several erosion control measures common along the Lake Erie shore that may not be appropriate for this application. For example, revetments are likely the most common erosion prevention structure along Ohio's Lake Erie coast. A revetment along Sheldon Marsh would be effective in stabilizing the shore to a fixed location and preventing future recession or breaches. However, due to the limited sand supply in the area, hardening the shore with a revetment may increase erosion of the beaches and nearshore when the revetment is subject to wave action. This could damage the barrier beach and nearshore habitats at the nature preserve.

Sand Management:

1. *Conserve Sand Resources:* *Conserve sand resources within the shore and nearshore areas. Sand is a limited resource in constant fluctuation. Avoid removing sand from the system; sand moved or excavated during construction along the shore should be placed in the nearshore, not on the upland and should not be incorporated into the construction project.*

Sand is vital to sustaining the eroding barrier beach in this reach. The current sediment supply to the barrier beach is limited by several shore perpendicular structures in the vicinity of Sheldon Marsh. While the artificial headlands at the northwest and southeast ends of the beach help keep sand in the system, erosion still occurs due to cross shore transport and over washing of the barrier beach. The conservation of current sand resources at Sheldon Marsh is key to the sustainability of the barrier beach system.

2. *Beach Nourishment:* *Supplement the current sand supply with beach nourishment, also known as beach fill or pre-fill. Beaches protected by groins and detached breakwaters will benefit from initial nourishment (pre-fill during or directly after construction) and periodic re-nourishment. The sand used in these projects should be acquired from an upland source.*

Due to the limited sand supply at Sheldon Marsh beach nourishment must be considered as part of an erosion management plan to sustain the barrier beach. This recommendation is applicable throughout the reach. The addition of sand both in the nearshore and along the beach for dune creation would be beneficial. Beach nourishment would be most effective if used as part of

a larger erosion management project that included additional measures to prevent loss of the added sand.

A project that includes the addition of sand to the beach or nearshore at Sheldon Marsh should also include a terminal groin at the west end of the barrier beach to prevent sand from filling the entrance channel for the marina at the Point Retreat Condominiums. If designed appropriately this structure could also be effective in stabilizing the beach by increasing the efficiency of the headland structures at the west end of the beach.

3. *Vegetation:* *Encourage growth of native vegetation on the back beach. Beach vegetation encourages the formation of a dune system by holding sand in place and providing protection from wind. It is also possible to simply allow the natural succession of native plant species to grow along the beach.*

Native vegetation on the beach in this reach would be beneficial to help encourage dune formation and would assist in stabilizing the barrier beach. This recommendation should be applied along the length of the beach to provide protection from wind and help prevent sand blowing into the marshes at of the nature preserve.

4. *Detached Breakwaters:* *Detached breakwaters may be useful in areas where beaches are present or likely to form. Detached breakwaters aid in retaining a beach by limiting the wave energy reaching the shore causing sediment to settle out and be deposited. As opposed to groins which trap sand moving along the shore, properly designed and constructed detached breakwaters are intended to allow alongshore movement of sand. An initial beach nourishment (pre-fill) and periodic re-nourishment will often be advantageous to creating and retaining the beach behind the breakwater while limiting impacts to neighboring shorelines. Some regulatory agencies may require pre-fill and periodic nourishment as one of the design components for a project that includes detached breakwaters.*

Detached breakwaters would be effective in preventing erosion at Sheldon Marsh but the addition of hardened structures would drastically change the natural setting at the marsh. The impacts of hardening the shore should be carefully considered when planning for erosion management projects at Sheldon Marsh.

Detached breakwaters would function well in the shallow water throughout the reach and could be beneficial for reducing wave energy along the barrier beach. Detached breakwaters could be constructed either as prominent structures extending above the water surface or as a series of submerged

structures. Both types of structures prevent erosion by limiting wave energy along the shore.

Typical detached breakwaters extend above the water surface at common lake levels and provide a solid barrier to waves. Wave energy is primarily dissipated by waves breaking on the structure. Submerged breakwaters would provide similar protection from wave energy by creating an artificial reef. The reduced water depth above the breakwater causes waves to break before reaching shore. The placement of submerged breakwaters or artificial reefs should be carefully planned due to the risk of introducing navigation hazards. The structures should be clearly marked to reduce danger to recreational boat traffic to the marina at the Point Retreat Condominiums and the nearby Sawmill Creek Marina.

Another option would be to construct nearshore breakwaters adjacent to the current structures at the Point Retreat Condominiums and NASA Pumping Station, in the approximate location of the submerged roadway. The breakwaters could increase the effectiveness of the existing structures as headlands to stabilize the embayed beach forming at Sheldon Marsh. The shape and stability of the beach is dependent on the orientation of the headland structures in relation to prevailing wind and wave directions.

Beach nourishment or sand pre-fill should be included in any design of a detached breakwater. This is especially important considering the limited sand supply at Sheldon Marsh.

Bank Modifications:

5. Dune Construction: Natural sand dunes prevent erosion by providing protection to the landward areas from waves and wind while acting as a sand reserve for the beach and nearshore areas. With sufficient sand supply beaches will naturally form dunes as sand accretes on the beach during calm wave conditions and is eventually piled along the shore by wind. The sand formations are gradually stabilized by vegetation and provide natural protection to the shore. The formation of mature sand dunes requires excess sediment supply for a considerable time period and is rare along Ohio's Lake Erie coast. An effective dune system can be created through dune construction by beach nourishment and vegetation. In some cases dune construction is assisted with structural measures such as snow fences or dune ladders. An artificial dune system will require regular monitoring and occasional maintenance through the addition of sand or planting of vegetation.

Dune construction would be a beneficial solution for providing natural erosion protection along Sheldon Marsh. A mature dune system would provide protection to the marshes, prevent breaching and provide a sand reserve for future erosion of the beach and nearshore. With a sand dune system these benefits could be accomplished while maintaining or enhancing the natural coastal wetland, barrier beach and nearshore habitats of the nature preserve.

The disadvantage of dune construction in an area prone to erosion is the



March 17, 2009: This photo was taken standing at the northwestern most portion of Sheldon Marsh State Nature Preserve's barrier beach just south of the channel that separates Point Retreat Condominiums (PRC) and the preserve. The letters "NPS" denote the NASA Pump Station at the east end of the reach. The E shows the location of the embayment.

potential loss of sand from the system and the excessive costs of maintenance. Although recent erosion rates at Sheldon Marsh have been reduced, there is a risk that any sand added to the system could eventually be eroded. The design of an artificial or supplemented dune system should include a plan for monitoring and future maintenance.

Management and Monitoring:

6. *Coordination of Projects:* Continuation of similar erosion control measures along a stretch of shore will often yield more effective protection than the installation of multiple types of structures adjacent to one another. Most erosion control measures function better when utilized over large areas of the shore.

The reach from the end of Cedar Point Road to the NASA Pumping Station is currently a continuous barrier beach isolated from the surrounding littoral system by artificial headlands. Any future projects should be focused on preserving this continuity and increasing the stability of the barrier beach. The construction of groins or structures intended to separate the beach into smaller beach compartments would likely reduce the effectiveness of the structures by causing areas of localized erosion and accretion.

The conditions at the artificial headlands at the ends of the barrier beach should also be carefully considered in the design of future erosion management projects. The stable form of an embayment is determined by the orientation of the adjacent headlands with respect to the prevailing direction of the wind and waves in the area. Future projects should be designed to increase the effectiveness of the adjacent structures in preserving a stable beach at Sheldon Marsh.

7. *Shore Structure Management-Monitoring:* Monitor and maintain shore structures. Routine monitoring of shore structures will allow for early detection of any potential failures. Smaller repairs performed more frequently will be less costly and can often increase how long the structure will be effective at controlling erosion. Should removal of an aged or deteriorating structure be necessary, consider the above recommended items as potential future solutions.

Due to the history of severe erosion and breaching of the barrier beach at Sheldon Marsh the condition of the shoreline should be closely monitored. If new erosion control measures are installed, the recommendations listed above should be considered. As previously discussed, a combination of recommendations may be the most effective solution. For example, dune



Snow fences placed at the western end of the Reach help stabilize the beach by stopping sand from blowing from the lake into the marsh to the south.

construction and beach fill would supplement the existing barrier beach and provide protection for the coastal wetlands at Sheldon Marsh.

References:

- Carter, Charles H. and Donald E. Guy. Report of Investigations No. 122, Lake Erie Shore Erosion, Ashtabula County, Ohio: Setting, Processes, and Recession Rates from 1876 to 1973. State of Ohio, Department of Natural Resources, Division of Geological Survey, Columbus, 1983.
- Ohio Department of Natural Resources, 1998 Final Coastal Erosion Area (CEA) Mapping
- Ohio Department of Natural Resources, 2010 Final Coastal Erosion Area (CEA) Mapping

Learn More:

LESEMP Webpages: ohiodnr.com/tabid/20501.default.aspx

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