Lake Erie Shore Erosion Management Plan

# Cedar Point to Vermilion - Reach 03

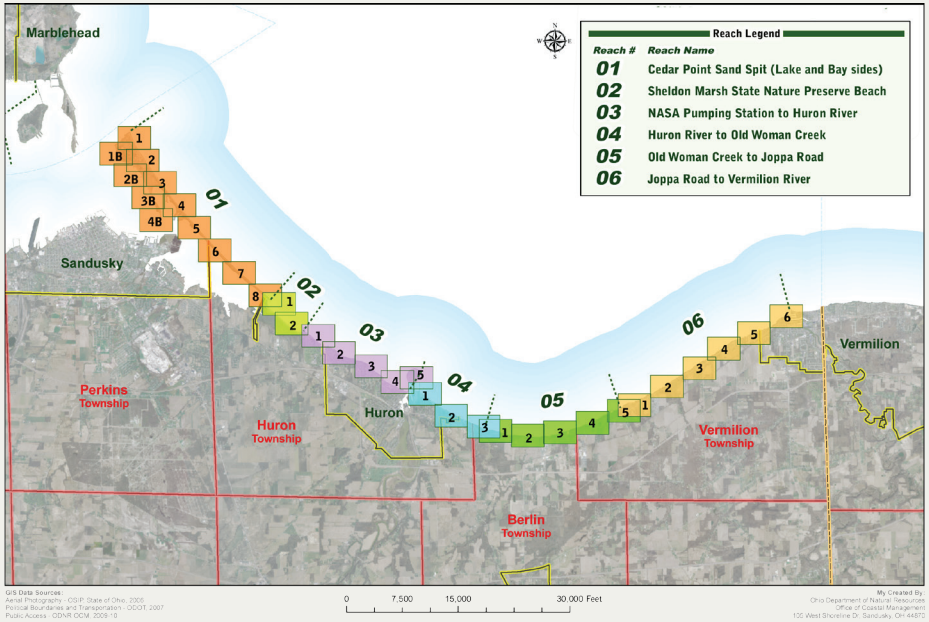
LESEMP

## 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.




*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.*

## Description

Reach 3 of the Cedar Point to Vermilion Region extends from the NASA Pumping Station east of Sheldon Marsh to the confined disposal facility (CDF) along the west bank of the Huron River. This reach contains approximately 17,000 feet (3.22 miles) of shore, not including the length of the jetty and CDF at the mouth of the Huron River. The reach is mostly comprised of private property with extensive residential and commercial development.

The shore in this reach is generally oriented from northwest to southeast but has several small headlands and embayments. Most irregularities along the shore are the result of manmade structures. The irregular shore is generally the result of small amounts of sand accumulating updrift of structures and greater erosion in small gaps between structures.

The structures at Huron Harbor play an important role along the coast of Reach CV 03. A large amount of sand has been trapped updrift (east), of the structures limiting sediment supply to the area. This reach has experienced significant erosion as a result. In response, the shore has been nearly completely armored with a variety of revetments and seawalls.

At the west end of the reach an approximately 500-foot long beach has accumulated east of the NASA Pumping Station. The beach and approximately 2,600 feet of armor stone revetment are lakeward of the golf course, condos and marina at Sawmill Creek Resort. The revetment extends for an additional 300 feet east of the marina entrance.

At the west end of the Rye Beach residential neighborhood, the coast bends to the northeast for about 200 feet then back to the southeast for 300 feet. An approximately 180-foot long pocket beach is supported by a 150-foot long concrete groin and detached breakwaters at Rye Beach. The east end of the residential area consists of approximately 900 feet of shore protected with armor stone, poured concrete and concrete rubble.

East of Rye Beach the shore bends about 175 feet to the south. A small pocket beach at Willow Grove is trapped between armor stone revetments. Similar 150-foot and 200-foot pocket beaches are trapped between properties with armor stone revetments to the east. The next 3,300 feet of

shore is fairly regular, characterized by transient beaches lakeward of small protective structures and residential development. Several properties include small groins, although most are damaged and submerged.

East of the Oakshire and Lake House East Condominiums, the shore begins to bend farther to the southeast. The next 1,700 feet of shore is protected by a nearly continuous armor stone revetment. Narrow beaches occasionally form lakeward of the revetments but sand accumulation is hindered by the overall lack of sediment in the area.

At the west end of Superior Drive, several properties are protected by small seawalls that are nearly continuous for about 700 feet. The east end of Superior Drive is protected by a series of armor stone revetments. Several properties along the east end of Superior Drive also have small groins or piers extending into the lake. These structures are generally for lake access as sand accumulation in this area is minimal.

East of an approximately 100-foot long groin, the shoreline steps landward about 175 feet at the mouth of Turtle Creek (Heimburger Ditch). The next 800 feet of shore is sand beach backed by a low armor stone revetment along Turtle Bay. East of Turtle Bay, about 800 feet of shore is protected with armor stone and concrete rubble. The next 300 feet of shore is accessible to the public at Huron's Waterplant Beach. East of the beach the next 500 feet of shore is protected with a variety of structures along Sail Away Drive.

The coast bends to the northwest approximately 125 feet at Huron's Lake Front Park. Sand fills the area between the toe of the bluff at Lake Front Park and a detached breakwater that runs for about 445-feet of the park's 615-feet of coast. The shore then steps landward about 120 feet before curving lakeward along a 500-foot stretch of shore which has a variety of seawalls and revetments along the stretch that includes residences and businesses.

The Huron Rotary Centennial Park connects the shore to the base of the shore-parallel jetty known as the Huron Harbor West Pier. The pier extends north into Lake Erie two-thirds of a mile and is marked with a 72-foot-tall lighthouse. In addition to protecting the Huron Harbor channel, the west jetty serves as the east end of the 68-acre CDF for dredged material. The D-shaped containment facility extends approximately 1,600 feet to the northwest.

The large embayment created by CDF and the jetty have trapped a large volume of sand and fine sediment due to the reduction of wave energy in the area. This process has caused a gradual accumulation of sediment, reducing water depths at the east end of the reach. Fine sediment often settles out along the base of the west jetty while the sand has created submerged sandbars that extend from the middle of Lake Front Park's detached breakwater east nearly 700-feet and north 1,230 feet to the south caisson of the CDF.

For Reach CV 03, nearshore slopes range from about 1 degree for the first 100 feet to about 0.5 degrees farther offshore. The net direction of

*The above photos were taken at the westernmost part of Reach CV 03 while standing atop the revetment along the east side of the NASA Pumping Station. The wave action was caused by the remnants of tropical hurricane winds that cause a counter-clockwise rotation of the air mass over Lake Erie. These waves often splash over the shore structures saturate the land behind. The eastern reaches of Sawmill Creeks 500-foot long beach are visible in the right photo.*

littoral currents in the area is from east to west. Sand transport to this area is impeded by the large structures at the Huron Harbor. As a result sand deposits are generally less than 1-foot thick. Thicker deposits of very fine sediment are located in the embayment protected by the confined disposal facility. The shore generally consists of low banks of glaciolacustrine clay.

## 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. During the time period from 1877 to 1973 the shore in this area experienced slow, consistent erosion.

The jetties at Huron Harbor were originally constructed between 1827 and 1831. The structures were lengthened in 1908 and between 1933 and 1935. The structures have prevented littoral transport of sand to the downdrift shore (to the west of Huron Harbor). Due to the lack of sand supply (and a period of very high water coupled with very severe storms) most beaches in this reach had eroded by 1973. Recession rates during this time period were generally 1 to 3 feet per year but reached 3 to 5 feet per year in localized areas such as immediately downdrift of Huron Harbor and near the mouth of Sawmill Creek. Recession rates began to decrease near the end of the period as the shore was developed and structurally protected.

From 1973 to 1990 the recession rates ranged from 0 feet per year to 8.1 feet per year. Recession was greatest at the far west end of the reach on the beach updrift of the NASA Pumping Station and at the mouth of Turtle Creek (Heimburger Ditch). Recession was generally less than 0.5 feet per year for most of the reach as the shore was nearly completely protected.

From 1990 to 2004 recession rates ranged from 0 feet per year to 1.6 feet per year. Overall recession rates were significantly reduced as nearly the entire shore is armored. Most of the shore experienced little to no recession. Recession was greatest at small gaps between structures or where existing structures were aging and in need of maintenance. In recent years the area at the east end of the reach between the shore and the Huron CDF appears to be accumulating silt and very fine sand.

*03/13/2012: Steel sheet pile on picture's left marks the entrance for the marina at Sawmill Creek (above). Stitched photos show the 150-foot Rye Beach groin and shore westward with condos at Sawmill visible far right (below).*

*03/13/2012: An ~ 180-foot long pocket beach is supported by a 150-foot long concrete groin on the west and detached breakwaters at Rye Beach (above). The east end of the Rye Beach residential area is of ~ 900 feet of shore protected with armor stone, poured concrete and concrete rubble (below).*

*03/13/2012: A pocket beach at Willow Grove is trapped between two armor stone revetments (above). Looking west at a detached breakwater north of Canton Avenue (below). The red roof is on the same building in both pictures.*

*03/13/2012: A narrow beach exists from Canton Avenue east to Bucyrus Avenue. The detached breakwater that is norht of Canton Avnue in this picture is the same as shown in the middle picture.*

## Flooding

This reach contains low lying areas that are susceptible to flooding as well as erosion. Floods have usually been associated with gales from the northeast, which may occur when tropical storms or the remnants of hurricanes migrate to the northeastern United State 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 protective structures in the area. If the storm coincides with a period of high water, the effect is intensified.

## Beaches/Sand Supply

Small beaches exist updrift (east) of the NASA Pumping Station and in embayments created by gaps between structures. Narrow transient beaches also occasionally form lakeward of shore protection structures for most of this reach. The presence of transient beaches demonstrates that there is some sediment available in this area. However, sediment transport into this reach is significantly limited by the large shore-perpendicular structures at Huron Harbor. The harbor structures have contributed to significant erosion of downdrift beaches. The hardening of the shore with protective structures has also contributed to the overall decrease in sediment supply.

## Use of Shore Structures

The dominant shore structures in this reach are the jetties and confined disposal facility at Huron Harbor. These structures have had a significant impact throughout this reach. In response, individual property owners have constructed a wide range of erosion control structures. The most common structures are revetments constructed with armor stone, rip-rap or concrete rubble. Concrete seawalls and sheet pile bulkheads have also been used to stabilize the shore in this area. Several properties have small shore-perpendicular structures although most are in poor condition and partially submerged. Many of the submerged groins in the area were likely constructed to stabilize beaches that have since eroded completely. Newer shore-perpendicular structures appear to be constructed as piers for lake access as there is limited sand available in the area.

## Summary

The reach from the NASA Pumping Station to the Huron River primarily contains residential and commercial property. Nearly the entire shore of this reach is armored with protective structures. The large shore-perpendicular structures at Huron Harbor have prevented the flow of littoral material to this area, significantly reducing sediment supply. As a result the beaches in this area have experienced slow, consistent erosion. Future erosion of the transient beaches lakeward of protective structures is possible. Recent recession rates have decreased due to the heavily armored coast. Under most circumstances, future bluff erosion will likely be limited to gaps between structures and to properties where damaged structures are not repaired.

# *Recommendations*

The recommendations included below are options that may be applicable within this reach and should only be used for planning purposes. Based upon the above physical characteristics the following recommendations are suggested for the reach between the NASA Pumping Facility and the Huron River. 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. This may be a viable, and even favorable, alternative for much of Ohio's Lake Erie shore. Much of this reach has low erosion rates. In areas where the shore is already heavily armored additional protection might not be necessary. In these areas attention should be focused on monitoring and maintaining the structures. In other areas, particularly those with a natural shore and low erosion rates, the best option may be to hold development back from the shore and allow natural erosion/accretion processes to occur.

*03/13/2012: From offshore, looking east at the shore area north of the terminus of Bucyrus Avenue (above), looking southeast at the shore at the northern terminus of Erie Avenue (below), and looking east from offshore of Ashland Avenue (bottom).*

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

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Office of Coastal Management
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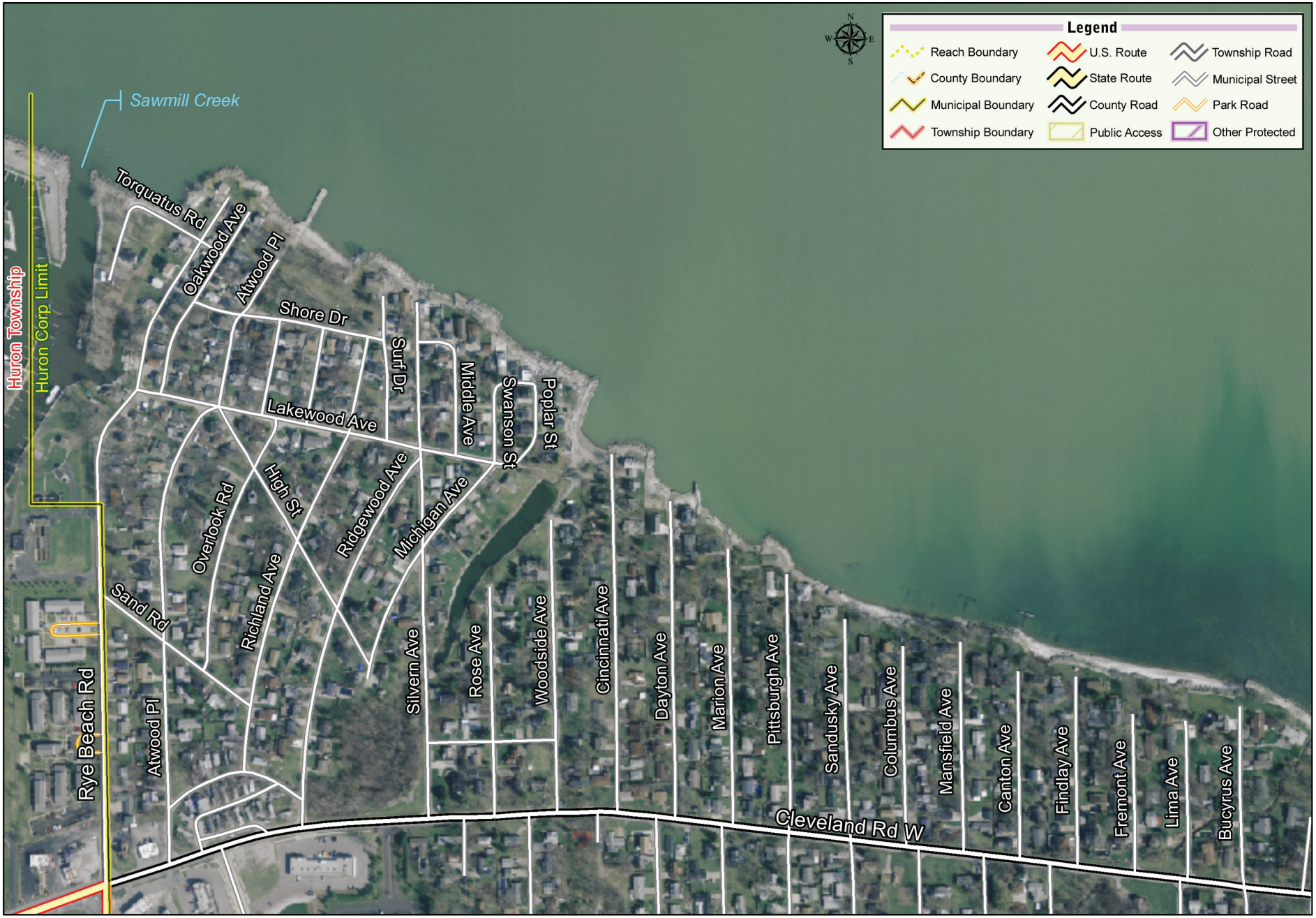


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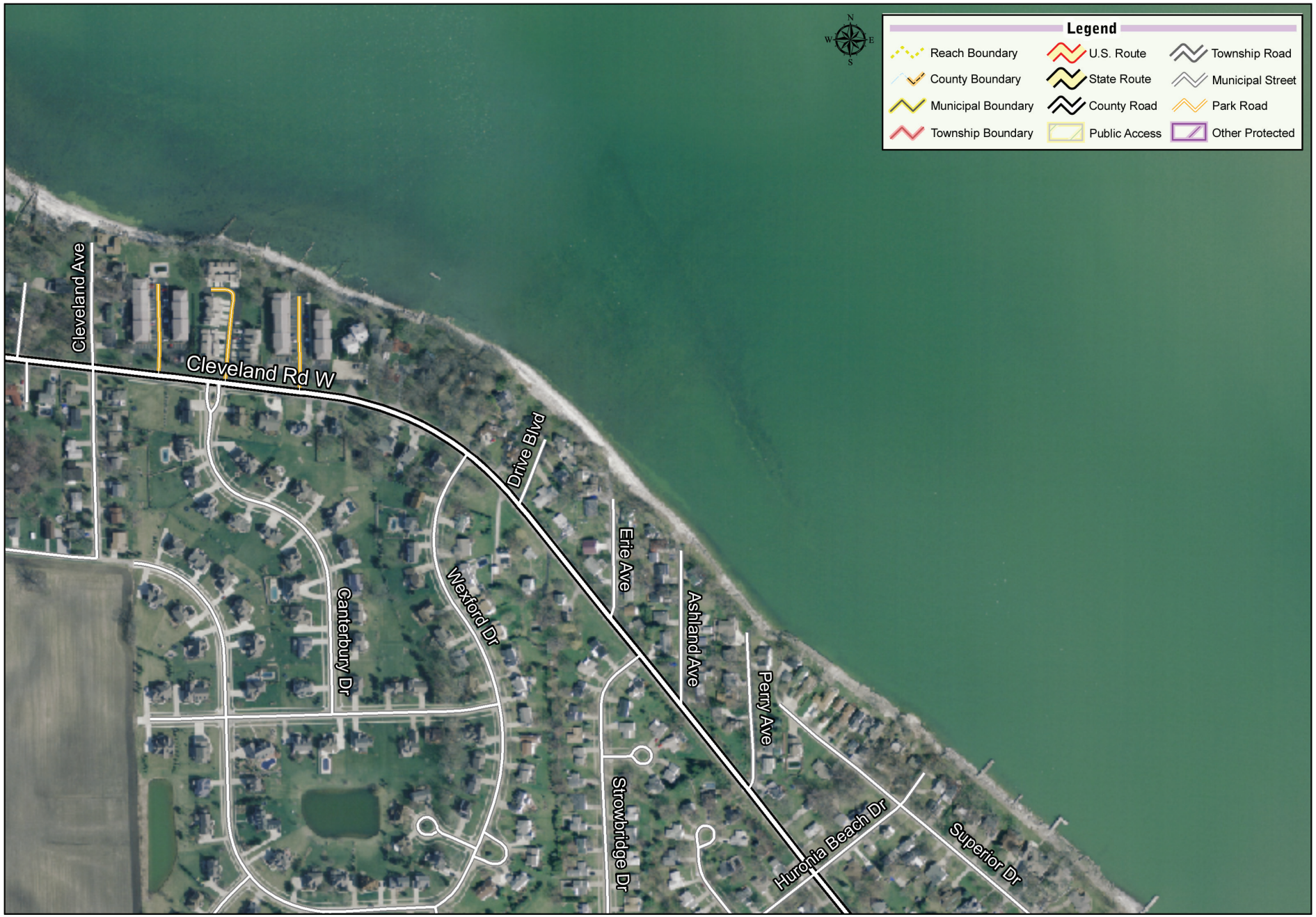


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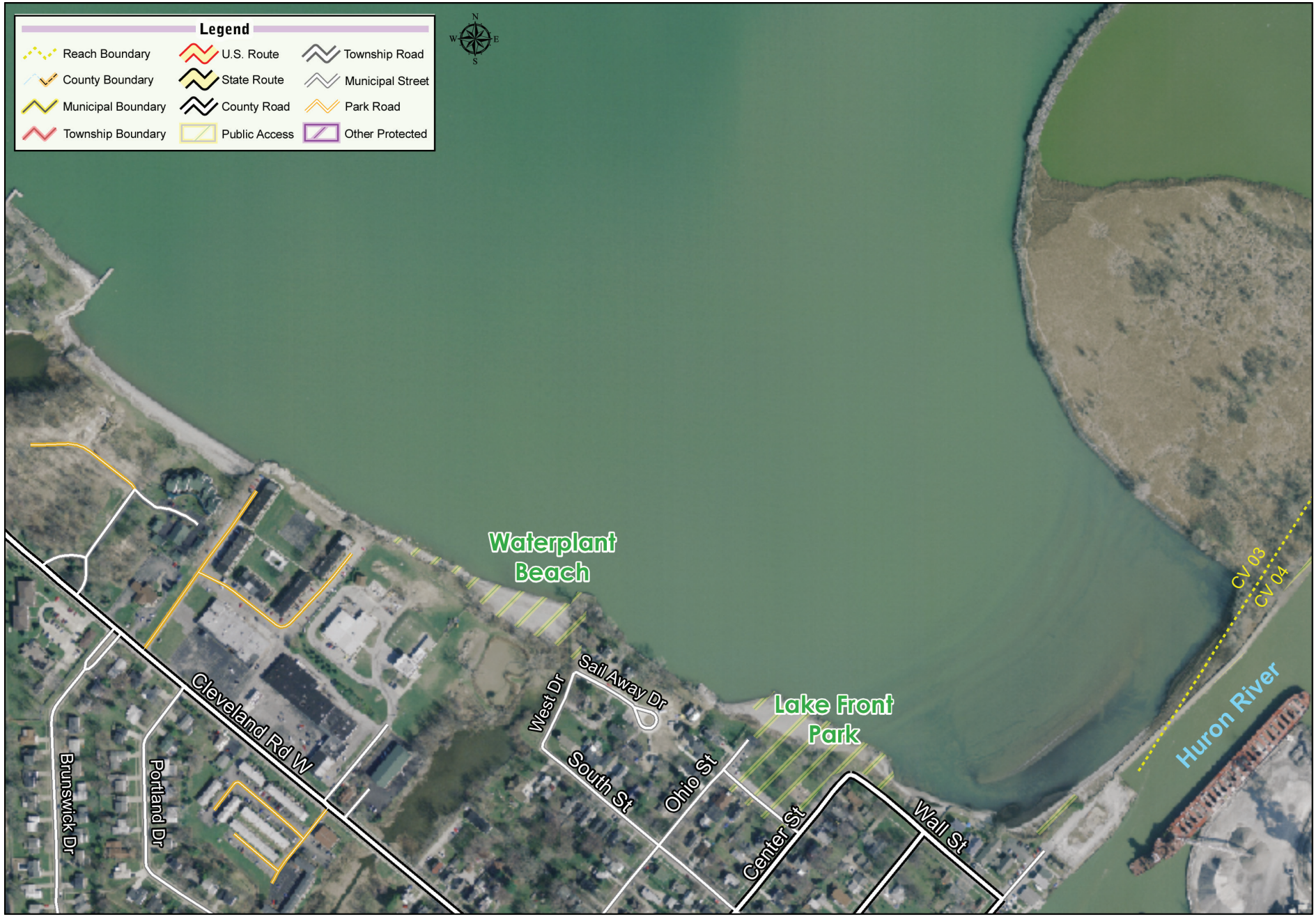


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## Sand Management:

***1. <u>Conserve Sand Resources</u>: 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.***

This recommendation applies to the entire reach. Sand supply to this reach is limited by the shore-perpendicular structures at Huron Harbor making the conservation of current sand resources vital to preventing future erosion in this reach. Particular attention should be paid to conserving sand resources during construction, repair or removal of shore structures as sand can be lost during these projects.

***2. <u>Beach Nourishment</u>: 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 in this reach beach nourishment may necessary for sites that rely on beaches for shore protection. These would include the two city of Huron beaches (Waterplant and Lake Front) and the beach at Sawmill Creek. The addition of beach nourishment would be especially beneficial if added to sites with existing beach stabilization structures (groins or detached breakwaters) or as part of new construction.

***3. <u>Vegetation</u>: 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 allow the natural succession of native plant species to grow along the beach.***

Native vegetation on the beaches in this reach would be beneficial to help encourage dune formation and would assist in stabilizing the remaining beach areas. Beach vegetation also provides protection from wind and can help prevent sand from blowing onto upland areas. This recommendation would be especially beneficial along the beach at the west end of the reach updrift (east) of the NASA Pumping Station or along the smaller area at Huron's Waterplant Beach.

*03/13/2012: The shore north of the Superior Drive in Huron has a variety of erosion control measures (above). Northeast of the terminus of the intersection of Superior Drive and First Street, a groin extends into the lake. East of the groin, the Heimburger Ditch empties into Lake Erie on the west side of the Turtle Bay community's stone revetment which is fronted by a narrow beach (below)*

*3/13/2012: Looking east (left) and west (right) from offshore of hte middle of the Turtle Bay community.*

***4. <u>Sand Bypassing</u>: Move sand from areas of excess accretion, usually updrift of a shore perpendicular structure, to areas downdrift. By redistributing sand within the nearshore system, the littoral drift in the area will be more evenly dispersed.***

Sand bypassing would be beneficial at Huron Harbor. The harbor jetties and CDF have impeded the flow of littoral material, trapping sand on updrift beaches and reducing sediment supply to the shore of this reach. Bypassing future accreted sand may reduce erosion at downdrift properties lacking structural protection and would aid in restoring the beaches in this area.

***5. <u>Dredging</u>: Dredge marinas and harbors on as frequent a basis as possible to add sand into the littoral system. Dredging of navigation channels at harbors and marinas enhances navigation for boaters and provides sand for downdrift areas when placed along the shore. When dredged material is disposed of on the upland or in offshore areas, the material is no longer a benefit to the littoral system. In-lake placement is preferred as long as the sand meets the grain size and total organic carbon criteria. Uncontaminated dredged material that is composed of sand and gravel should be placed in the nearshore through sidecasting or placing downdrift. In order to nourish downdrift beaches sand must be placed in water shallow enough to be influenced by littoral currents.***

Material dredged from the entrance to Huron Harbor that contains high levels of contaminants must be placed in a confined disposal facility. This results in a large amount of material being permanently removed from the littoral zone. If future pollution control and upland runoff measures are successful and the dredged materials become suitable for the nearshore environment, nearshore placement would be highly beneficial to the area west of the harbor.

This recommendation may also be applied if the entrance to the Sawmill Creek Marina requires maintenance dredging.

## Toe Protection:

***6. <u>Detached Breakwaters</u>: 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 renourishment will often be advantageous to creating and retaining the beach landward of the breakwater while limiting impacts to neighboring shores. 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 function well in the shallow water throughout the reach and could be effective protection for the remaining beaches in this reach. Detached breakwaters could also be used to enhance or restore the narrow transient beaches to their previous conditions. To be effective in an area with limited sand supply detached breakwaters need to be constructed over a long stretch of shore. Sand pre-fill and periodic beach nourishment would also be necessary for detached breakwaters to be effective in this area.

*03/13/2012: Looking west from offshore north of the city of Huron's water plant. The top of the bluff above the concrete rubble shows evidence of slumping (left). 11/03/2011: TheWashburn Ditch flows into Lake Erie along the east side of the city's Waterplant Beach shown from the shore looking west (right).*

A beach monitoring and sand bypassing plan should also be included in the design of the detached breakwaters to prevent excessive sand accumulation during periods of unanticipated environmental conditions.

***7. Revetments: Revetments along the toe of a bank will aid in protecting against wave-based erosion. In areas without beaches, a structural measure may be necessary to protect the toe of the bank. The low-relief banks within this reach have relatively gradual slopes, which are ideal for revetment development. In essence the revetments form a stable bank slope, providing protection to the soil underneath while breaking up wave attacks. Since material eroded off the bank is one source of beach-building sand, some regulatory agencies may require that one of the design components for a revetment be the inclusion of sand pre-filling in the amount equal to that which would have been added to the system over the life of the structure.***

Revetments are the most common erosion prevention structure in this reach and have been effective at stabilizing the shore and minimizing erosion in the area. An approximately 2,600-foot long revetment protects much of Sawmill Creek Resort and revetments are common along Cleveland Road and Superior Drive.

Care should be taken in applying this recommendation in areas with existing or frequent transient beaches. Armoring the shore with hard structures can result in increased erosion at the toe of the structures due to downcutting if the transient beach is flooded and the structures are subjected to wave action.

## Bank Modifications:

***8. Surface Water Management and Flood Protection: Low lying areas should be protected from excess surface water and flooding from the lake and from upland runoff. In areas prone to flooding. Erosion protection should include surface water management design elements such as collection areas, retaining structures, and drainage ditches or culverts. Surface water should be routed away from the face of the bank. In areas where gullies or rills are forming, surface water is slowly eroding the face of the bank. Where possible, re-route water away from the bank toward a planned collection area and drainage system.***

This reach consists of highly developed, low lying lake plains that are susceptible to flooding and erosion. The presence of water pooled on the upland or slumping of the bank face are potential signs of surface water issues. Surface water flows, including storm water outflows, can cause extreme localized erosion in beach areas or the nearshore. Surface water should be routed away from the bank or beach whenever possible.

***9. Vegetation: Encourage growth of vegetation along the bank slope. Where possible plant vegetation, preferably native species, along the bank to remove excess ground water while retaining soil strength. It is also possible to simply allow the natural succession of native plant species to grow along the bank.***

Planting native vegetation on the upland above the seawalls, revetments and other shore structures in this reach would reduce excess surface water and help stabilize the low banks. Vegetation should be closely monitored on the actual structures. For example, vegetation growing on a rip-rap or armor stone revetment could damage the structure by causing stones to be broken or displaced.

*11/2/2011: were stitched together to create the panoramic view in the bottom photo which stretches from the Huron Confind Disposal Facility and west jetty of the Huron River in the background to the city's Lake Front Park in the foreground right and center to looking west at the shore fronting private residences.*

## Management and Monitoring:

***10. <u>Bank-Top Management</u>: Keep heavy materials, equipment or structures well back from the edge of the bank-top. Any structure (concrete decks, stone walls) or heavy object (vehicles or construction equipment) placed near the bank edge will increase the stress within the soil and can lead to slope failure.***

This recommendation applies to the low banks and structure crests throughout this reach. Many of the residential structures in this reach have been placed immediately landward of seawalls or bulkheads. Further development near the crest of these structures could cause damage. Care should also be taken when maintaining shore structures or accessing the area with vehicles or other equipment to prevent damage.

***11. <u>Coordination of Projects</u>: 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.***

This recommendation is applicable throughout this reach. In residential areas, coastal property is often divided into parcels as small as 50 feet wide with each property owner responsible for their own shore protection. This leads to a mix of structures with varying designs, construction quality and condition. The interaction between these structures often limits their effectiveness and at times can increase erosion at the site or on adjacent properties as exhibited by the irregular shoreline near the center of this reach. This is best avoided by coordinating projects over a length of shore. There are stretches in this reach where several properties are protected by one continuous structure. When these structures require maintenance or replacement, coordinating projects to retain or increase the continuity of structures should be considered. Coordinating projects between neighbors can also allow some engineering and construction expenses to be spread over several properties.

When structures can not be continued across multiple properties, conditions at the ends of the structure should be carefully considered in the design. The structures should be designed to prevent intersections causing increased wave energy or gaps between structures where erosion is likely. The nearly continuous revetment along the shore of the Lake House and Oakshire Condominiums, continuing along the shore to the east, is a good example of properly aligning the ends of separate structures.

***12. <u>Shore Structure Management/Monitoring</u>: 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.***

Many of the structures in this reach were constructed more than 30 years ago. The condition of the structures should be closely monitored and repairs should be made when necessary. If new erosion control measures are installed the recommendations listed above should be considered. A combination of recommendations may be the most effective solution. For example, neighbors with an eroding beach and several failing groins may consider coordinating on a project to remove the groins and protect the shore with an armor stone revetment or construct detached breakwaters with sand pre-fill.

## 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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