Lake Erie Shore Erosion Management Plan

Western Basin: Reach 09

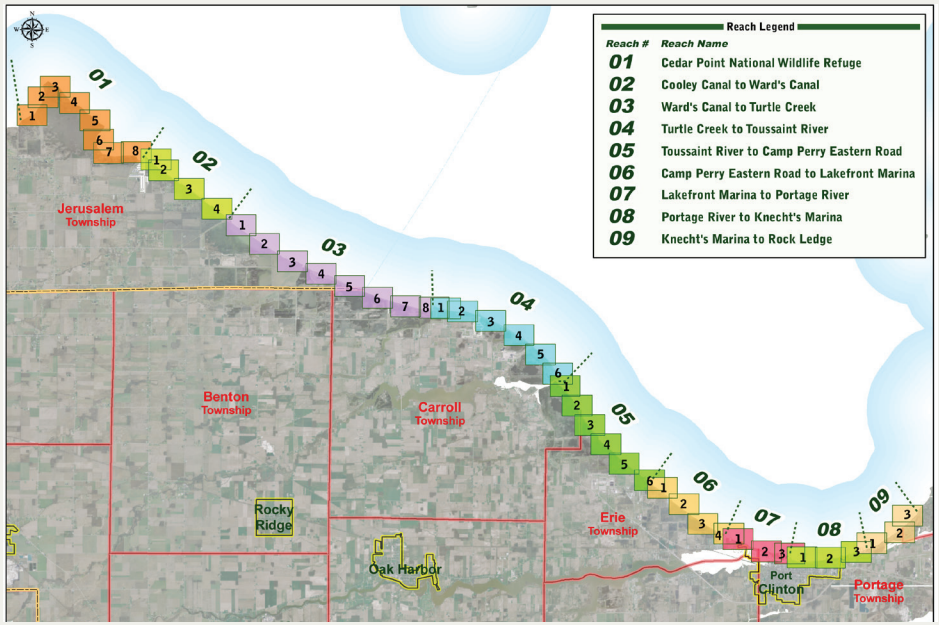
LESEMP

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 9 of the Western Basin Region extends from Knecht's Marina to the first outcropping of dolomite bedrock at Rock Ledge in Catawba Island Township. This reach contains approximately 10,000 feet of shore and includes the residential community along Sand Road east of Port Clinton.

The coast in this reach is oriented from southwest to northeast along the east side of the Port Clinton embayment. The shore is fairly uniform and slightly concave lakeward. The reach from Knecht's Marina to Rock Ledge is entirely residential development. The shore is extensively protected and is nearly completely armored with only a few gaps between structures.

At the west end of the reach approximately 300 feet of sand beach has accumulated up-drift of the east breakwater at Knecht's Marina. The beach and an additional 300 feet of steel sheet pile bulkhead front the campground at Knecht's Marina. The same sheet pile bulkhead extends an additional 250 feet at the west end of the Sand Road residential area. The next 1,200 feet to the east is protected with a series of steel sheet pile bulkheads and concrete seawalls. Approximately 700 feet of this area is protected by a single steel sheet pile bulkhead that continues along several properties. The bulkhead is divided into thirds with the center segment protruding about 50 feet into the lake. There are several steel sheet pile groins extending into the lake from this bulkhead.

The next 700 feet of shore to the east is protected by a series of concrete seawalls set back about 50 feet onto the upland. The properties in this area are fronted by a narrow beach. The beach is widest at the west end and narrows to the east. The next 225 feet of shore is protected with a steel sheet pile bulkhead. A groin field begins approximately 100 feet into the bulkhead, often trapping sand lakeward of the east half of the bulkhead. The next 400 feet of shore to the east is sand beach stabilized with groins spaced about every 100 feet. Most of the properties in this area include a seawall placed directly lakeward of the residential structures for flood protection but some properties are unarmored.

To the east the shoreline steps lakeward approximately 50 feet at a concrete groin. The groin supports the west end of a 1,000-foot long sand beach. The

coast in this stretch is fairly uniform although the placement of protective structures varies from property to property. The next 600 feet is protected by a series of revetments and seawalls west of another 1,000 feet of sand beach supported by groins spaced every 80 to 100 feet. Many of the properties in this area also include low seawalls or bulkheads placed immediately lakeward of upland structures for flood protection.

The next 1,200 feet to the east is protected by a series of steel sheet pile bulkheads and concrete seawalls placed close to the shore with very little beach lakeward. The following 1,200 feet have similar steel sheet pile bulkheads and seawalls but includes two sections where the structures are set back slightly for four to five properties. Narrow beaches are stabilized in these areas by short groins.

In the reach's eastern 1,000 feet, the relief of the upland begins to gradually increase from 3 to 4 feet in the beach areas at the west end of the reach to a 7 to 8 foot embankment. The embankment is generally protected with concrete seawalls or steel sheet pile bulkheads. A few properties are protected with stone revetments.

Nearshore slopes in this reach range from about 1 degree for the first 100 feet to about 0.3 degrees farther offshore. The net direction of littoral currents is from northeast to southwest. Littoral currents are generally stronger at the east end of the reach and weaken as they reach the center of the Port Clinton embayment at the west end of the reach. Nearshore sand deposits are greater at the west end of the reach as material collects in the Port Clinton embayment and decrease to the northeast. The entire reach includes several nearshore sand bars becoming more defined as sand increases at the west end of the reach. Lakeward of the sand deposits glacial till and till lag deposits of muddy sand and gravel are exposed, although sand is present on the lakebed in much of the Port Clinton embayment.

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.

From 1877 to 1973 this reach experienced slow recession with the west end of the reach fairly stable and recession rates generally increasing to the east. As the residential area along Sand Road was developed, erosion became extremely localized to unprotected areas of the shore. While erosion during this time period varied during times of high or low water, long-term average recession rates ranged from 0.2 feet per year to 1.5 feet per year. Less than 1,000 feet of shore experienced long-term average recession rates greater than 1.0 feet per year.

The shore along Rock Ledge on Catawba Island looking southwest (left photo) and looking northeast (right photo).

By 1973 the shore was nearly completely developed. From 1973 to 1990 average recession rates ranged from 0 feet per year to 0.4 feet per year. Recession was extremely localized and limited to small gaps between structures. From 1990 to 2004, average recession rates remained low and ranged from 0 feet per year to 0.3 feet per year. Recession was minimal over the entire reach as the shore is nearly completely armored.

Flooding

The low-lying banks of this and the surrounding reaches 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 United States 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 shore structures, flooding the upland behind them. If the storm coincides with a period of high water, the effect is intensified. Although the area is extensively armored with protective structures, the residential development in this reach is often placed extremely close to the shore, making the area especially vulnerable to flooding.

Beaches/Sand Supply

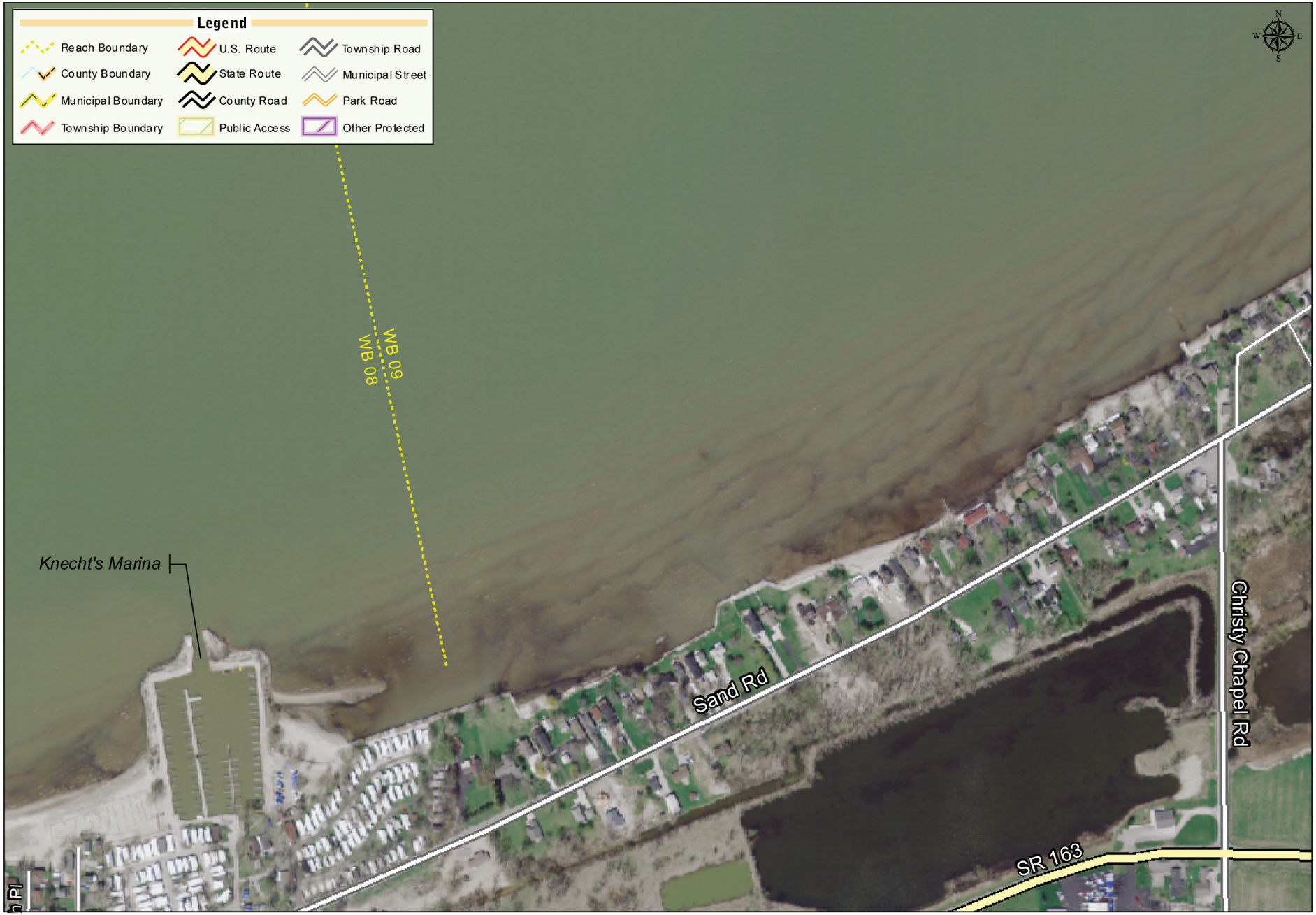
The numerous beaches and the presence of sand bars in the nearshore zone demonstrates the availability of sand in this reach. The presence of sand lakeward of vertical seawalls and bulkheads is also an indication of large sand deposits in the area. Vertical structures often cause downcutting and scour of lakeward beaches. Along this reach the sand bars and shallow nearshore zone often cause waves to break before reaching the structures. Many vertical structures are constructed upland of existing beaches as protection from flooding or severe storms. The beaches further decrease wave energy helping to prevent downcutting.

Sand deposits are greatest at the west end of the reach due to the overall accumulation of littoral material in the Port Clinton embayment. The sand supply generally decreases at the east end of the reach.

Use of Shore Structures

Individual property owners have constructed a wide variety of erosion control structures to protect the residential area along Sand Road. The shroe in this reach is almost completely armored with only a few small gaps between structures. The most common structures are steel sheet pile bulkheads and concrete seawalls. Many of the seawalls have been constructed on the upland to provide protection from severe storms or flooding while allowing a beach to exist lakeward. Beaches in this reach are often supported by short groins.

Portions of the coast north of the residential community on Sand Road are shown in this photo.



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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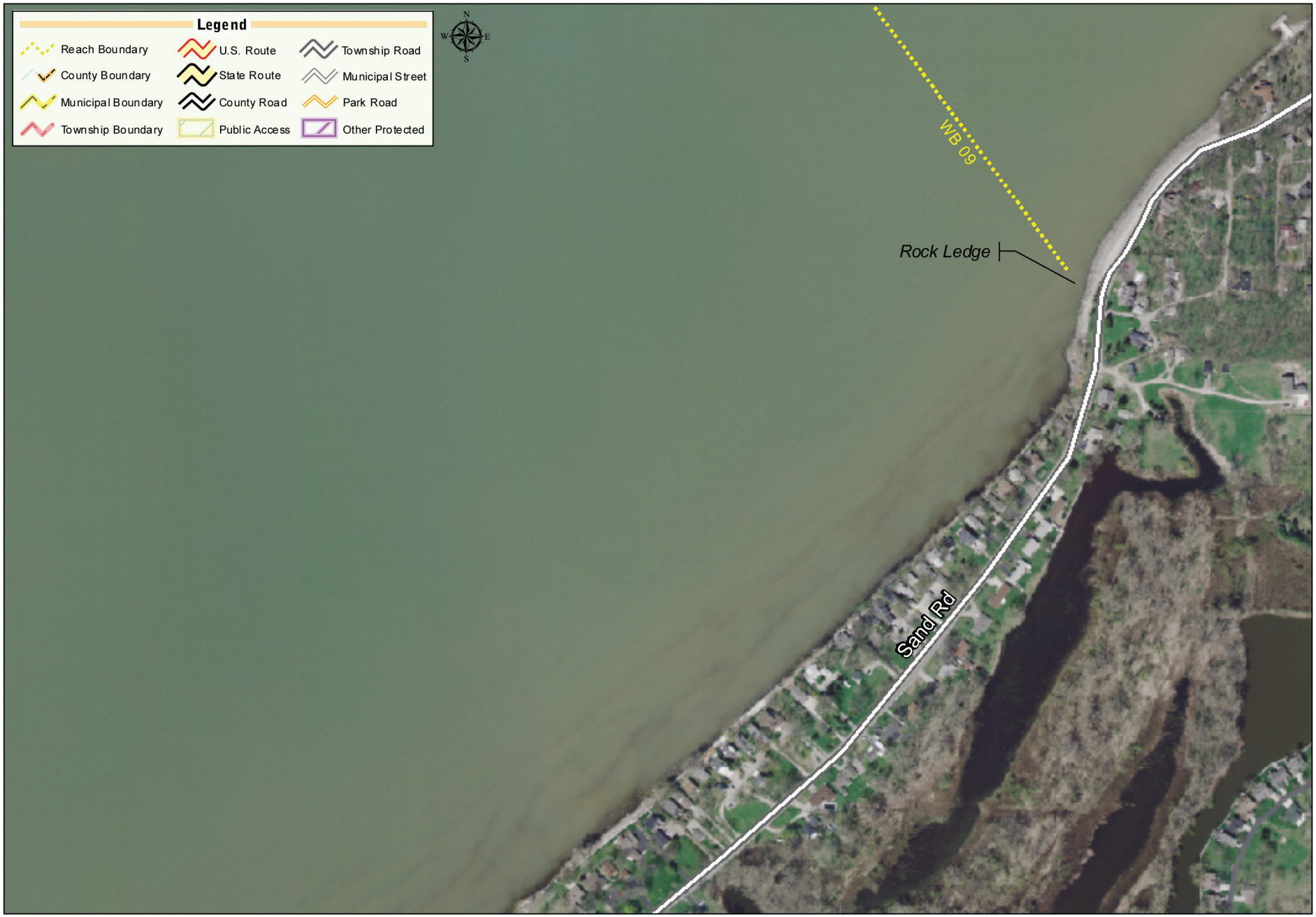

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Summary

The reach from Knecht's Marina to the first outcropping of dolomite bedrock at Rock Ledge in Catawba Island Township has historically experienced slow recession. Erosion in this area has been limited by extensive residential development and the shore structures constructed to protect it. This reach is nearly completely armored with only a few small gaps between structures. Erosion has also been limited by the large deposits of sand available in this area. There are several well-developed sand bars present in the shallow nearshore zone. These bars provide protection from breaking waves and material for beach creation. Several properties have taken advantage of the availability of littoral material by constructing protective structures on the upland allowing beaches to form. As a result of the extensive structure protection and availability of sand in the littoral zone, future erosion will likely be limited to times of high water or severe storms.

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 Reach WB 09: Knecht's Marina to Rock Ledge. 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. The Knecht's Marina to Rock Ledge reach generally has a stable shore and has low erosion rates. In areas where the shore is protected with effective structures 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 shoreline and low erosion rates, the best option may be to hold development back from the shore and allow natural erosion/accretion processes to occur.

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.

While there is sand is available in the littoral system this recommendation should be considered throughout this reach. The sand available in the nearshore zone is relied on to prevent waves from breaking on structures and to provide beach material. A reduction of sand in the littoral system

A portion of the coast north of the residential community on Sand Road is shown in this photo.

would decrease the effectiveness of many protective structures, leaving residential properties vulnerable to erosion and flooding.

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 renourishment. The sand used in these projects should be acquired from an upland source.

This recommendation is applicable throughout the reach. The addition of beach nourishment would be especially beneficial if added to sites with existing structures to stabilize it or as part of new construction for detached breakwaters.

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 simply 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 shore. This recommendation would be most beneficial on the wider beaches at the west end of the reach, particularly the beach fronting the campground at Knecht's Marina.

Toe Protection:

4. <u>Detached Breakwaters</u>: Detached breakwaters may be useful in areas where beaches are present or likely to form. As opposed to groins which trap sand moving along the shore, properly designed and constructed detached breakwaters will aid in retaining a beach by limiting the movement of sand offshore (perpendicular to shore) while still allowing for the alongshore movement of sand. An initial beach nourishment (pre-fill) and periodic renourishment 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 function well in the shallow water throughout the reach and would be beneficial for most of the reach. Many properties in this reach have seawalls or low revetments placed landward of beaches to protect upland structures while preserving existing beaches. Detached breakwaters are another alternative that would provide erosion protection while preserving existing beach areas.

Beach nourishment or sand pre-fill should be included in the design of a detached breakwater to prevent the structure from trapping littoral material and increasing the risk of erosion on adjacent properties.

Vegetation growing at he back of the beach, as show in the left photo of Walnut Beach in Ashtabula, encourages the formation of a dune system which can hold sand in place. Detached breakwaters, similar to those at Lakeview Park in Lorain shown in the right photo, may be useful in areas where beaches are present or likely to form.

*5. **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.*

While there are a few revetments in this reach, particularly at the east end of the reach, most properties are protected with concrete seawalls or steel sheet pile bulkheads. If these structures need maintenance or replacement, revetments should be considered. Many of the seawalls and bulkheads were constructed immediately lakeward of upland structures to allow existing beaches to remain. A revetment will provide similar protection against storm waves and flooding but has the advantage of dissipating wave energy rather than reflecting it into the nearshore zone. This reduces the risk of downcutting and would help prevent erosion of the beaches fronting many of the structures in this reach.

Bank Modifications:

*6. **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 is comprised of highly developed, low lying lake plains. Much of this reach has been stabilized with seawalls and other shore structures to protect upland development very close to the shore. Surface water flows, including storm water outflows, can cause extreme localized erosion. Surface water collecting on roadways, residential roofs, or driveways near the shore should be routed away from the bank or beach whenever possible.

*7. **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 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.

Management and Monitoring:

*8. **Bank-Top Management**: 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.

*9. **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.*

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 can lead 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. 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. This often occurs in areas where the structure

was built prior to the upland being subdivided into several parcels. 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.

Revetments are common in Reach 09. This large revetment at the east end of the reach is shown from on top looking southwest (top) on bottom looking northeast (bottom).

10. <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, to further protect upland structures fronted by an existing beach, a revetment landward of the beach or detached breakwaters with sand pre-fill may be considered.

References:

- Benson, D. Joe. Draft Open File Report 96-xxx (final publication number not assigned), Lake Erie Shore Erosion and Flooding, Ottawa County, Ohio. State of Ohio, Department of Natural Resources, Division of Geological Survey, Columbus, 1978.
- 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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