

Western Basin: Reach 05



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.

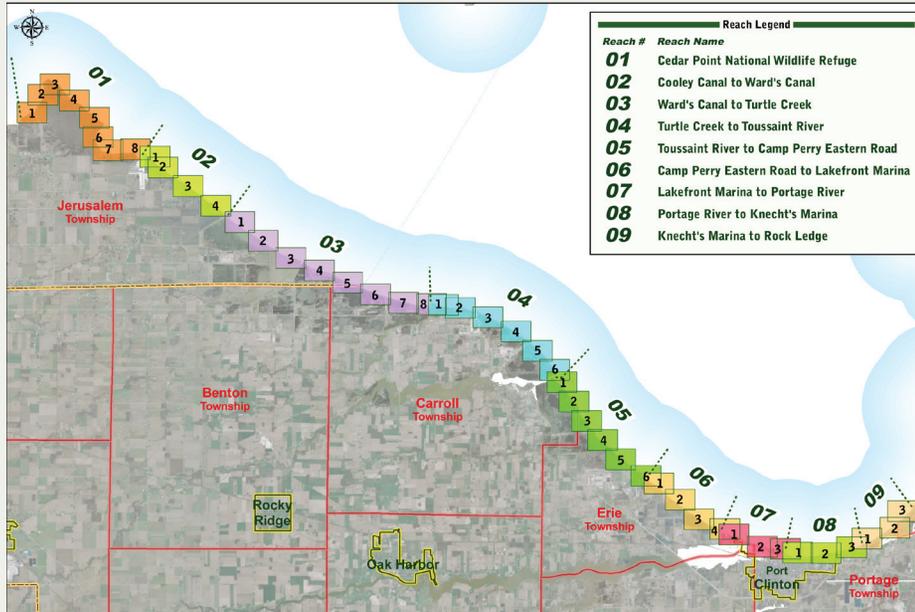
Description

Reach 5 of the Western Basin Region extends from the Toussaint River to Camp Perry Eastern Road. This reach contains approximately 21,000 feet of coast and includes the Toussaint Shooting Club, Erie Industrial Park and Camp Perry Military Reservation. The entire reach is included in the Camp Perry Military Exercise Danger Area. Access to the area is limited due to military training, equipment testing and the presence of military ordinances or munitions.

The shore in this reach is oriented in a northwest to southeast direction and is fairly uniform. At the west end of the reach the nearshore includes sand formations due to both littoral processes and channel shoaling at the mouth of the Toussaint River. The river banks in the area of the Ottawa National Wildlife Refuge (to the north) and the Toussaint Shooting Club (to the south) are stabilized with rip-rap dikes but the mouth of the river is not armored. This area is highly dynamic and is particularly sensitive to storms and changes in water level. The sand formation at the mouth of the river is variable and constantly changing size and location.

The next 14,200 feet of coast is made up of barrier beach between the lake and the marshes at the Toussaint Shooting Club and Erie Industrial Park. Several ponds in the marsh are separated by earthen dikes to control water levels. In some areas the earthen dikes back up the barrier beach along the shore. The dikes are partially armored with small rip-rap in some areas. About 10,400 feet southeast of the mouth of the Toussaint River the shore steps to the south approximately 300 feet along a bend in an armored portion of the dike. About 3,000 feet farther is a large rubble structure with two fingers extending approximately 250 feet into the lake.

About 400 feet southeast of the rubble structure begins the 5,200-foot long dike fronting the Camp Perry Military Reservation. The Camp Perry Dike is a rip-rap structure backed by a steel sheet pile seawall in some areas, particularly near the relic base of the old Camp Perry Pier. The Camp Perry Dike is backed by discontinuous ditches and retention ponds along most of its length. A narrow sand beach fronts the dike near the southeast end and is most pronounced directly adjacent to the rubble mound pier base structures. The dike protects the shooting ranges at Camp Perry that were reclaimed



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.

from the marsh when the camp was constructed in the early 1900s.

At the end of the Camp Perry Dike is the Camp Perry Pier. The current pier was constructed in 1980 to replace the badly damaged original pier. The pier extends about 1,000 feet to a 200-foot “L” at the lakeward end. A substantial amount of sand has accumulated on both sides of the pier with the large recreational beach to the east. The recreational beach is backed by the 950-foot long Camp Perry seawall. This structure was originally built in 1930 to protect the clubhouse and other upland structures. At the east end of the reach, four 100-foot long groins spaced at 100 feet were constructed in 1952 to stabilize the beach at the end of the Camp Perry seawall.

The net direction of the littoral current in this reach is from northwest to southeast. Littoral currents in the area are generally weak and the west end of the reach is often an area of diverging currents. This contributes to the sand accumulation on the southeast side of the Toussaint River and helps explain the overall recession and limited sand supply in the area of the Toussaint Shooting Club. The lack of sediment accumulation up-drift of the

shore perpendicular structures in this reach also demonstrates the weak and sometimes variable littoral drift in the area as well as the limited sediment supply in this reach.

Nearshore slopes range from about 1 degree for the first 100 feet to about 0.4 degrees farther offshore. Sand deposits generally extend 500 to 1,000 feet offshore before exposing glacial till and till lag deposits of muddy sand and gravel.

The western portion of the reach is comprised of barrier beach backed by earthen dikes and occasionally armored with rip-rap. This portion of the reach is highly susceptible to erosion.

The eastern portion of this reach is protected with the dike and seawall at the Camp Perry Military Reservation. Erosion in this portion of the reach will likely be limited to the narrow beaches fronting the dike or the recreational beach trapped by the Camp Perry Pier. The shore in this area is well protected and expected to be stable.



East of the Camp Perry Pier, a public recreational beach is backed by the 950-foot long Camp Perry seawall. This structure was originally built in 1930 to protect the clubhouse and other upland structures. The seawall separates the paved road and the sand in the left photo which is taken from the tower looking east. The right photo is taken from standing on top the seawall in front of the Camp Perry Clubhouse and looking west at the base of the pier.

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.

The Division of Geological Survey described the recession of this reach during the time period from 1877 to 1973 as slow to moderate. The eastern portion of the reach has been most stable and that stability has increased with the development of Camp Perry and the construction of shore structures. The western portion of the reach has remained largely unarmored and has experienced greater erosion, with the shore receding between 400 and 500 feet from the 1970s to 2004. This area is extremely sensitive to water levels as most of the historical recession occurred during times of high water. Much of the reach has been stable or experienced minor accretion during periods of low water. The sand accumulation at the

mouth of the Toussaint River is highly dynamic and especially susceptible to erosion and accretion due to water levels and storm events. A considerable amount of sediment from the river is also trapped in the nearshore causing its stability to be even more variable.

From 1973 to 1990 recession rates ranged from 0 feet per year to 26.5 feet per year. Recession was greatest just east of a bend in the dike at the Toussaint Shooting Club. The barrier beach in this area was breached in several places. The dike fronting Camp Perry was effective in stabilizing the shore as the area experienced very little recession during this time period.

From 1990 to 2004 recession rates ranged from 0 feet per year to 4.9 feet per year. Recession was greatest in the same area of barrier beach at the Toussaint Shooting Club although this area did experience some accretion during this time period. Overall the beach was somewhat restored due to comparably lower water levels. During this time period the shore at Camp Perry was fairly stable and experienced very minor recession. Erosion in this area is generally limited to the beaches in front of the dikes or wears on the dikes.



The 5,200-foot long Camp Perry Dike is partially covered by vegetation in the left photo. At the end of the dike is the Camp Perry Pier (right photo). The pier was constructed in 1980 to replace the badly damaged original pier visible in the left photo. The new pier extends about 1,000 feet to a 200-foot "L" at the lakeward end.

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 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 dikes, flooding the upland behind them. If the storm coincides with a period of high water, the effect is intensified.

Beaches/Sand Supply

The long term recession of the barrier beaches demonstrates the limited sand supply in this reach. The weak and sometimes diverging littoral currents often transport sand from this area rather than allowing it to accumulate. A large amount of sand has accumulated near the mouth of the Toussaint River and adjacent to the Camp Perry Pier while other shore-perpendicular structures near the center of the reach have collected little sediment. There is additional sand available in the shallow nearshore zone which has allowed narrow beaches to exist even lakeward of the Camp Perry dikes.



At the east end of Reach 05, four 100-foot long groins spaced at 100 feet were constructed in 1952 to stabilize the beach at the end of the Camp Perry seawall (left photo). The right photo is taken from the pier looking southeast at the Camp Perry beach east of the pier. The clubhouse is in the background.

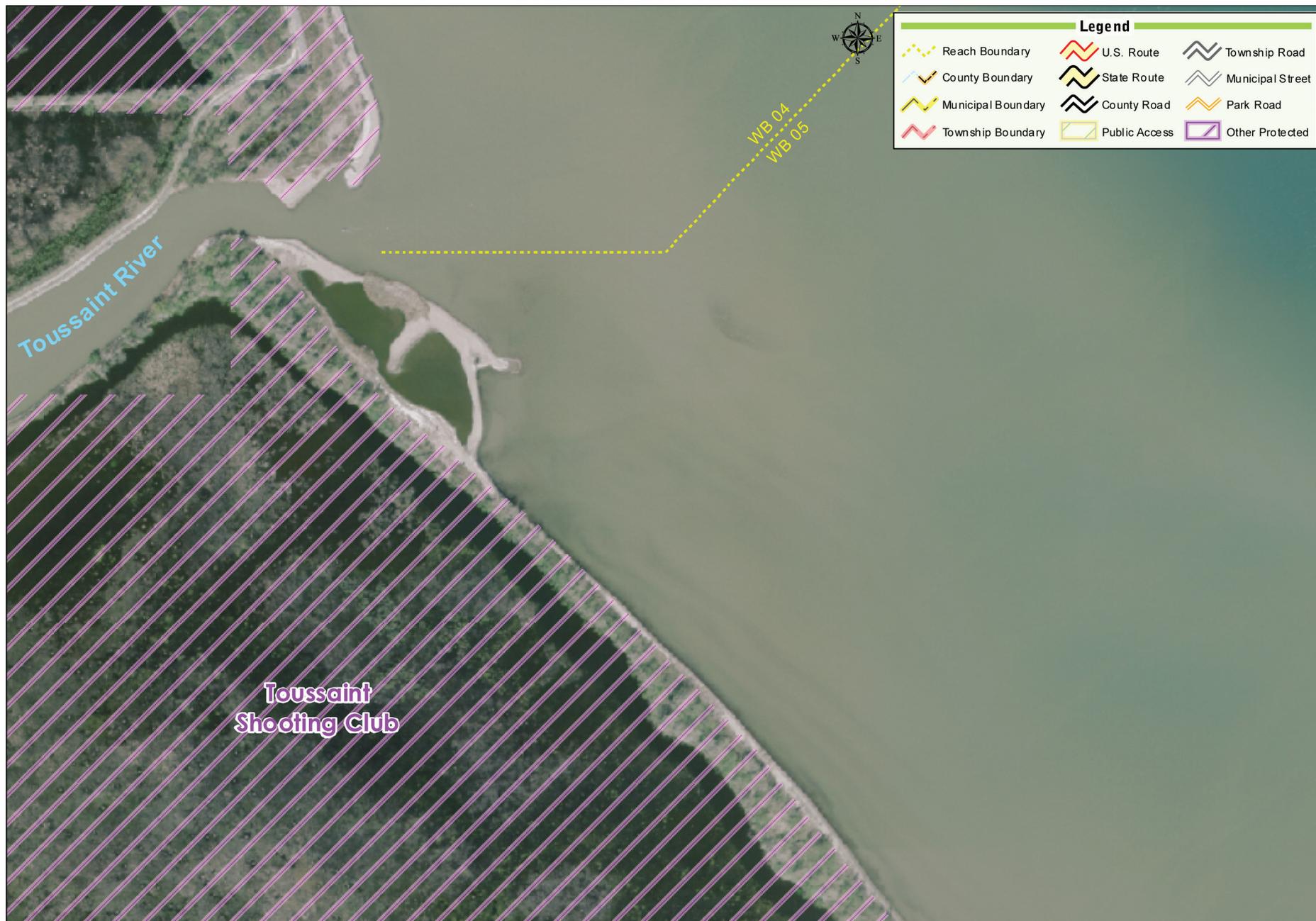
Use of Shore Structures

The predominant shore structures in this reach are the shore-parallel dike and seawall and the shore-perpendicular pier at Camp Perry. The dike and seawall have been effective at preventing recession at the eastern end of the reach. The Camp Perry Pier has also been effective in trapping a recreational beach and providing access to the lake. The dikes at the Toussaint Shooting Club have prevented the barrier beach from being breached in the areas where the shore is protected. Much of the shore at the Toussaint Shooting Club is barrier beach and unarmored.

Summary

The coast from the Toussaint River to Camp Perry Eastern Road includes the Toussaint Shooting Club, Erie Industrial Park and Camp Perry Military Reservation. A sand formation has accumulated southeast of the Toussaint River but is highly variable. The shore in the area of the Toussaint Shooting Club is primarily barrier beach backed by an earthen dike in some places and occasionally armored with rip-rap. The unprotected portions of the barrier beaches are extremely susceptible to erosion and are often breached in periods of high water. The shore at the Camp Perry Military Reservation is protected with a rip-rap dike, seawall and the beach trapped by the Camp Perry Pier. Future erosion will likely occur on the barrier beaches at the Toussaint Shooting Club. With adequate maintenance of the protective structures the shore at Camp Perry is expected to be stable.





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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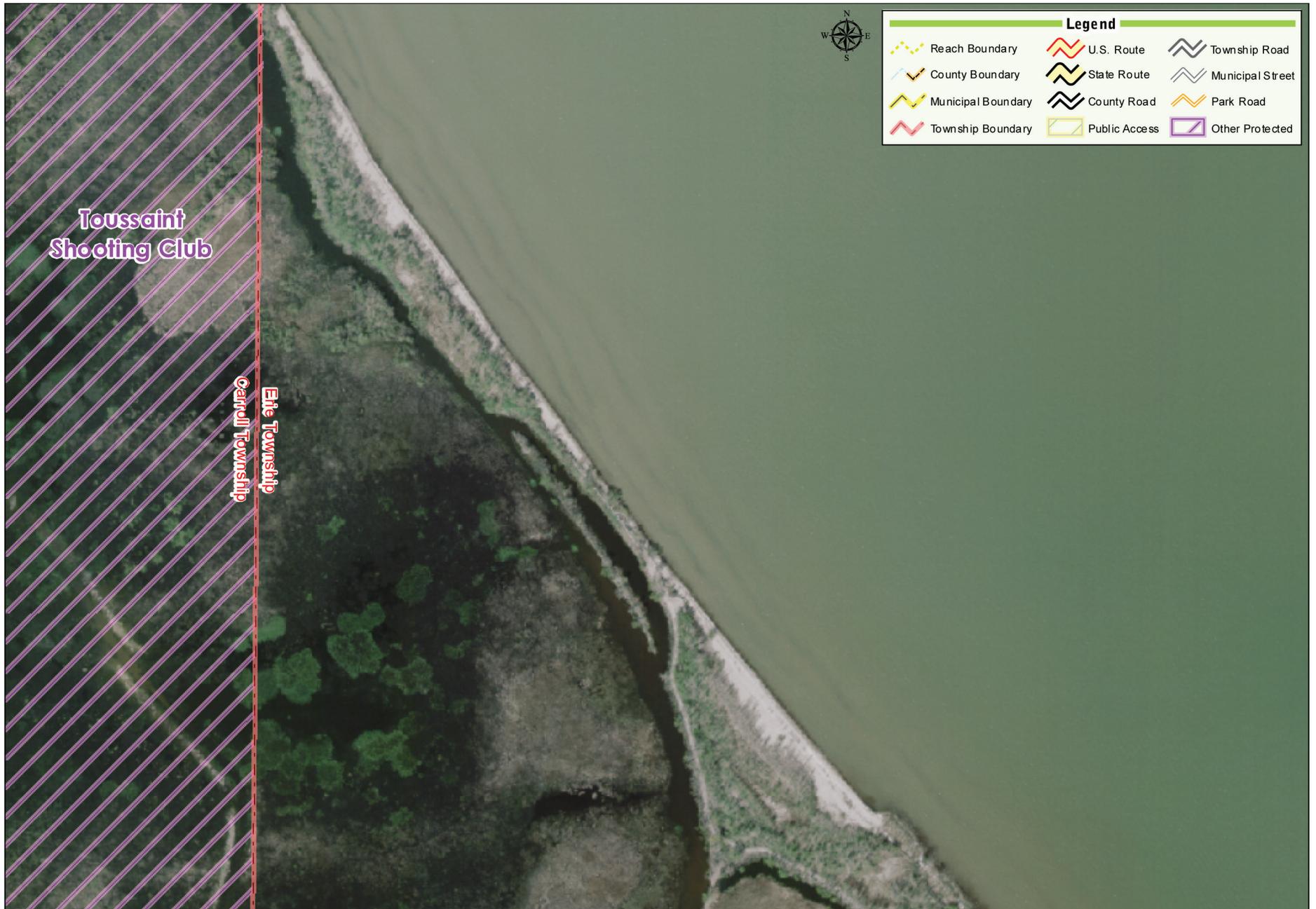


Legend					
	Reach Boundary		U.S. Route		Township Road
	County Boundary		State Route		Municipal Street
	Municipal Boundary		County Road		Park Road
	Township Boundary		Public Access		Other Protected

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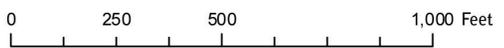
Toussaint Shooting Club

Carroll Township
Erie Township



Legend					
	Reach Boundary		U.S. Route		Township Road
	County Boundary		State Route		Municipal Street
	Municipal Boundary		County Road		Park Road
	Township Boundary		Public Access		Other Protected

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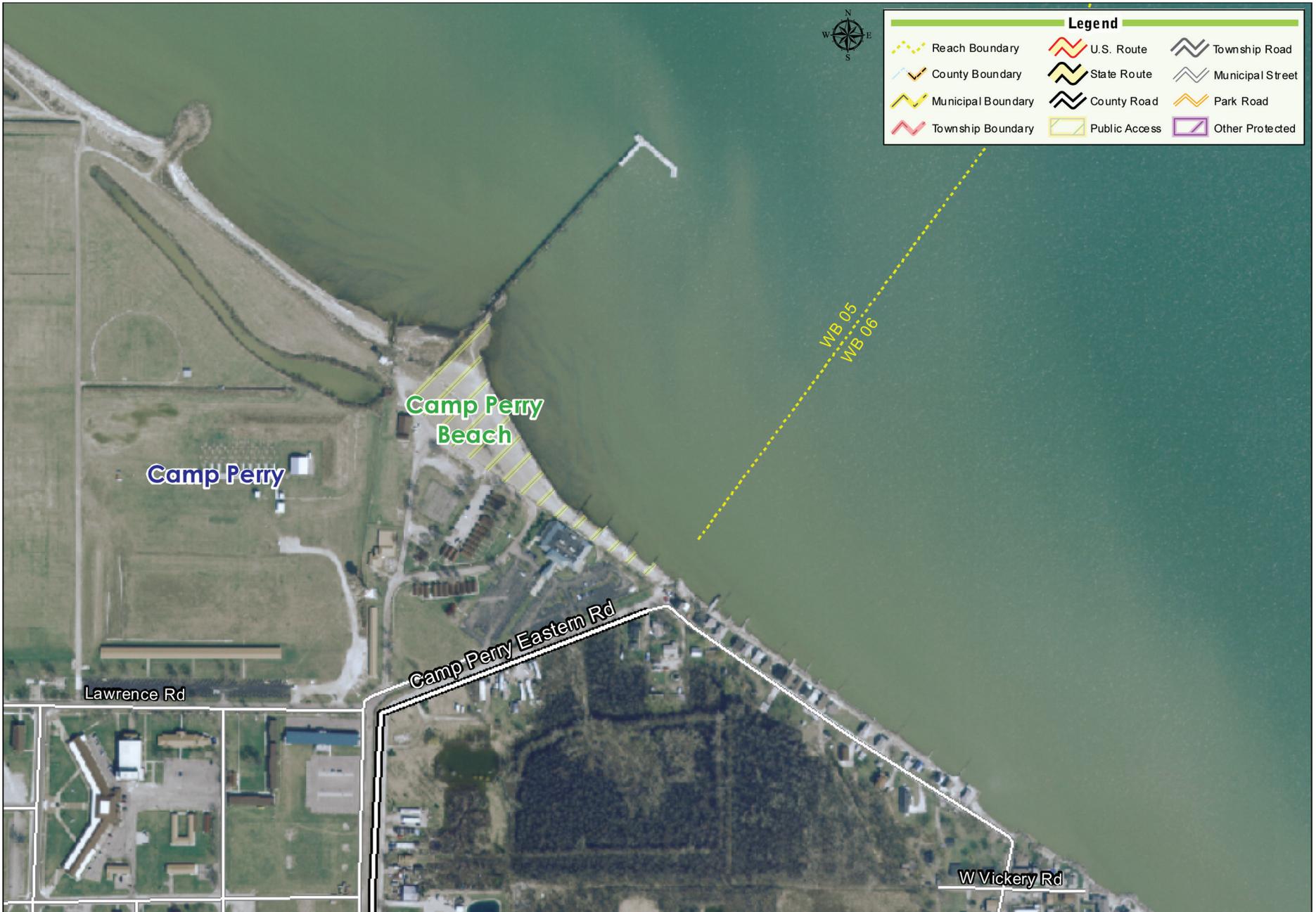
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Recommendations

The recommendations included below are options that may be applicable within this reach and should only be used for planning purposes. Based on the above physical characteristics, the following recommendations are suggested for the Toussaint River to Camp Perry Eastern Road 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 LESEMP 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. In areas where the shore is already heavily armored, such as Camp Perry, 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. This is especially favorable in areas like the Toussaint Shooting Club with existing barrier beaches.

Sand Management:

1. Conserve Sand Resources: *Conserve sand resources within the shore and nearshore areas. Sand is a limited resource in constant fluctuation.*



A large amount of sand has accumulated adjacent to the Camp Perry Pier at the eastern end of Reach 05 while other shore-perpendicular structures near the center of the reach have collected little sediment. The photos are taken standing on the pier looking southeast at the camp during summer and west during early spring.

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 is applicable to the entire reach. As sand resources are limited in this area conserving the sediment available is critical. The stability of the shore for much of this reach is dependent on the sand available to sustain the barrier beaches. Before any new structures are constructed, any sand or gravel in the foot print of the structure should be sidecast into the lake to prevent any material from being removed from the littoral system.

Aerial photos show a history of sand mining at the mouth of the Toussaint River. Removing material from the littoral system should be avoided as it may result in increased erosion on downdrift properties.

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

This recommendation is applicable throughout the reach but would be most effective along the barrier beaches fronting the Toussaint Shooting Club, particularly if paired with a shore structure to protect or stabilize the sand. Beach nourishment would also be effective in expanding the existing beach east of the Camp Perry Pier.



3. *Sand Bypassing:* *Move sand from areas of excess accretion, usually up-drift 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 if excessive accretion occurs updrift of the Camp Perry Pier or in the area of the Toussaint River. The sand could be used as nourishment for the barrier beaches at the Toussaint Shooting Club. The littoral drift in this area is weak and often variable care should be taken in determining a location to deposit bypassed sand.

4. *Dredging:* *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 dredge material that is composed of sand and gravel should be placed in the nearshore through sidecasting or placing downdrift. Placing sand in shallow water keeps the sand in the nearshore environment and the littoral system. Sand placed into deeper waters will likely be lost to the system and will not nourish downdrift beaches.*

If the marina entrances on the Toussaint River need maintenance dredging, nearshore placement of the dredge materials should be considered. If the

dredged materials are suitable for the nearshore environment, nearshore placement would be highly beneficial to nourish the barrier beaches in the area.

Toe Protection:

5. *Detached Breakwaters:* *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 effective protection for the barrier beaches fronting the Toussaint Shooting Club. Detached breakwaters could be used to enhance or restore the narrow barrier beaches in the area. 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 causing increased erosion on adjacent properties.



The shore in the area of the Toussaint Shooting Club is primarily barrier beach backed by an earthen dike and is armored in some places with rip-rap as seen along this stretch of coast.

6. 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.*

The lakeward face of the dikes fronting the Camp Perry Military Reservation are armored with rip-rap and form a low revetment along the east end of the reach. This structure has been effective in limiting coastal recession in this area. Shallow nearshore depths have allowed narrow sand beaches to form lakeward of the dike in some areas, particularly where shore perpendicular structures have trapped sediment near the east end of the reach.

The earthen dikes at the Toussaint Shooting Club were constructed to manage water levels in the marshes and were not intended as shore protection. The dikes at the Toussaint Shooting Club are armored with rip-rap in some areas. Additional armoring could help stabilize the shore in this area. The overall lack of available sediment and diverging littoral currents in this area would make revetments at the Toussaint Shooting Club particularly susceptible to downcutting and increased erosion in the nearshore zone. Care should be taken in applying this recommendation as it may lead to loss of the barrier beaches in this area.

Bank Modifications:

7. 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.*

The dikes at the Toussaint Shooting Club were constructed to manage

surface water within the marshes. Water levels in the marshes are primarily controlled to provide the necessary water depths for aquatic vegetation and suitable habitat for migratory birds. Excess surface water is routed to the Toussaint River.

The dikes at Camp Perry are backed by several ditches and ponds to retain excess surface water. This recommendation applies to the area east of the Camp Perry Pier. Surface water flows, including storm water outflows, can cause extreme localized erosion in beach areas. Surface water should be routed away from the bank whenever possible.

8. **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.

Beach vegetation is integral to dune formation as it holds the beach in place and provides protection from wind. Planting native beach vegetation would be especially beneficial in wider areas of the barrier beaches fronting the Toussaint Shooting Club. Planting native vegetation on the earthen portion of the dikes would reduce excess surface water and protect the dikes from wind. Native vegetation also provides habitat for shore birds and other wildlife. Vegetation on the dikes should be closely monitored to prevent tree roots from structurally undermining the dikes.

Additional vegetation would also be beneficial on the upland at the Camp Perry Military Reservation. Planting native vegetation would reduce excess surface water and help prevent flooding behind the dikes.

Management and Monitoring:

9. 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.*

While there are no high bluffs in this area, this recommendation does apply to the top of the dikes. It is unlikely that heavy structures or fill would be placed near the shore of the Toussaint Shooting Club but some of the dikes do include maintenance roads. Care should be taken when accessing the area with vehicles or other equipment to prevent damage to the dikes. This recommendation also applies to the dikes at Camp Perry.

10. 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. The benefit of continuing shore structures along a stretch of shore is demonstrated at Camp Perry. The coastal dike is about 5,200 feet long and ends directly adjacent to the Camp Perry Pier. The Pier has trapped a beach both in front of the eastern 500 feet of the dike and in front of the 950-foot long Camp Perry Seawall. The beach at the east end of the reach is stabilized with four small groins and extends directly up to structures at the residential properties in the next reach– WB 06. These structures have effectively limited coastal recession at Camp Perry.

The shore at the Toussaint Shooting Club could benefit from better continuity in shore protection. The areas of barrier beach where the dike bends away are often breached and experience the greatest erosion.



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, nourishment of the barrier beaches in this reach would be most effective when supported or protected by additional shore structures and continued over a long stretch of the coast.

11. 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.

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. When structural repairs are needed, construction should be managed to limit the effects on coastal habitat in the area. Carefully timing the repairs and maintaining several areas at once would minimize the impacts to coastal habitats.

The shore structures in this reach are particularly vulnerable to excessive water levels within the ponds at the refuge. The dikes at the Toussaint Shooting Club are generally unarmored. The dikes at Camp Perry are armored with rip-rap on the lake facing side but are constructed with earth fill facing the upland. Scouring from behind could undermine the levees.

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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