Woodtick Peninsula Section 204 Beneficial Use of Dredged Material for Ecosystem Restoration Project, Monroe County, Michigan

Draft Integrated Feasibility Report and Environmental Assessment and Draft FONSI

U.S. ARMY CORPS OF ENGINEERS
DETROIT DISTRICT
477 MICHIGAN AVE
DETROIT, MICHIGAN 42277

May 2022

Page Intentionally Left Blank

DRAFT FINDING OF NO SIGNIFICANT IMPACT

Woodtick Peninsula Section 204 Beneficial Use of Dredged Material for Ecosystem Restoration Project
Monroe County, Michigan

The U.S. Army Corps of Engineers, Detroit District (USACE) has conducted an environmental analysis in accordance with the National Environmental Policy Act of 1969, as amended. The draft Integrated Feasibility Report and Environmental Assessment (IFR/EA) dated **6 May 2022,** for the Woodtick Peninsula Section 204 Beneficial use of Dredged Material for Ecosystem Restoration Project addresses beneficial use of dredged material for ecosystem restoration opportunities and feasibility in Monroe County, Michigan.

The Final IFR/EA, incorporated herein by reference, evaluated various alternatives that would beneficially use dredged material from the Toledo Harbor Federal Navigation Project for wetland restoration within the vicinity of Woodtick Peninsula, and expand, restore, and enhance the existing coastal, emergent, and submergent wetlands to improve fish and wildlife habitat in the study area. The Tentatively Selected Plan is the **National Ecosystem Restoration (NER) Plan** and includes:

- The Tentatively Selected Plan includes in-water placement of dredged material from the Toledo Harbor Federal Navigation Project on the leeside of Woodtick Peninsula. Dredged material would be hydraulically placed to an elevation of 570.75 feet extending away from the peninsula at a 1:20 slope to bottom elevation of 562 feet. This placement elevation would create approximately 115 acres of submerged wetland habitat for Submerged Aquatic Vegetation (SAV) by increasing the bottom elevation so that a larger area is within the photic zone. This action also includes creation of an artificial reef made with geosynthetic containers (GSCs) that are filled with dredged material and have a various sized stone placed on top to form approximately 1/3 acre of hard-bottom native fish habitat. Stone sizes would range from 6 – 12 inches with some larger 3-feet diameter stone. The reef would be constructed off the southern end of Woodtick Peninsula. The GSCs would be placed in roughly a curved line to an elevation of approximately 566.2 – 566.5 feet. The reef would be approximately 1200 feet in length and require approximately 1200 cubic yards (CY) of dredged material. It would likely be partially exposed for part of the year, dependent on water levels. This plan would have a placement footprint of 115.3 acres and require approximately 156,000 CY of dredged material.

In addition to a "no action" plan, seven alternatives were evaluated.[1] The alternatives included Rebuilding the peninsula, rebuilding the peninsula and constructing a lakeside reef, dredged material placement at southern end of Peninsula and building an offshore reef, and dredged material placement at southern end of peninsula and two offshore reefs (Section 3).

[1] **40 CFR 1505.2(b) requires a summary of the alternatives considered.**

SUMMARY OF POTENTIAL EFFECTS:

For all alternatives, the potential effects were evaluated, as appropriate. A summary assessment of the potential effects of the recommended plan are listed in Table 1:

Table 1: Summary of Potential Effects of the Recommended Plan

	Insignificant effects	Insignificant effects as a result of mitigation*	Resource unaffected by action
Aesthetics	☒	☐	☐
Air quality	☒	☐	☐
Aquatic resources/wetlands	☒	☐	☐
Invasive species	☒	☐	☐
Fish and wildlife habitat	☒	☐	☐
Threatened/Endangered species/critical habitat	☒	☐	☐
Historic properties and Cultural Resources	☐	☐	☐
Floodplains	☐	☐	☒
Hazardous, toxic & radioactive waste	☐	☐	☒
Hydrology	☒	☐	☐
Land use	☐	☐	☒
Navigation	☒	☐	☐
Noise levels	☒	☐	☐
Public infrastructure	☐	☐	☒
Socio-economics	☐	☐	☒
Environmental justice	☐	☐	☒
Soils	☒	☐	☐
Tribal trust resources	☐	☐	☐
Water quality	☒	☐	☐
Climate change	☐	☐	☒

All practicable and appropriate means to avoid or minimize adverse environmental effects were analyzed and incorporated into the tentatively selected plan. Best management practices (BMPs) as detailed in the IFR/EA will be implemented, if appropriate, to minimize impacts.[2]

OTHER ENVIRONMENTAL AND CULTURAL COMPLIANCE REQUIREMENTS:

ENDANGERED SPECIES ACT

INFORMAL CONSULTATION:

Pursuant to section 7 of the Endangered Species Act of 1973, as amended, the U.S. Army Corps of Engineers determined that the tentatively selected plan may affect but is not likely to

[2] 40 CFR 1505.2(C) all practicable means to avoid and minimize environmental harm are adopted.

adversely affect the following federally listed species or their designated critical habitat: Indiana bat (*Myotis sodalis*), northern long-eared bat (*Myotis septentrionalis*), eastern prairie fringed orchid (*Platanthera leucophaea*). The U.S. Fish and Wildlife Service (FWS) concurrence is pending.

NO EFFECT:

Pursuant to section 7 of the Endangered Species Act of 1973, as amended, the U.S. Army Corps of Engineers determined that the tentatively selected plan will have no effect on the following federally listed species or their designated critical habitat: piping plover (*Charadrius melodus*), red knot (*Calidris canutus rufa*), eastern massasauga (*Sistrurus catenatus*), northern riffleshell (*Epioblasma torulosa ragiana*), rayed bean (*Villosa fabalis*), Karner blue butterfly (*Lycaeides melissa samuelis*).

NATIONAL HISTORIC PRESERVATION ACT

Currently, the effects the project will have on historic properties has not been fully determined, as the identification of historic properties in the area of potential effect are on-going. Under Section 106, a determination of effect will be submitted to consulting parties in the summer of 2022.

CLEAN WATER ACT SECTION 404(B)(1) COMPLIANCE

Pursuant to the Clean Water Act of 1972, as amended, the discharge of dredged or fill material associated with the tentatively selected plan has been found to be compliant with section 404(b)(1) Guidelines (40 CFR 230). The Clean Water Act Section 404(b)(1) Guidelines evaluation is found in Appendix I of the IFR/EA.

CLEAN WATER ACT SECTION 401 COMPLIANCE:

401 WQC PENDING:

A water quality certification pursuant to section 401 of the Clean Water Act will be obtained from the Michigan Department of the Environment, Great Lakes, and Energy prior to construction.

COASTAL ZONE MANAGEMENT ACT

CZMA CONSISTENCY PENDING:

A determination of consistency with the Michigan Coastal Zone Management program pursuant to the Coastal Zone Management Act of 1972 will be obtained from the Michigan Department of the Environment, Great Lakes, and Energy prior to construction.

FINDING

Technical, environmental, and cost effectiveness criteria used in the formulation of alternative plans were those specified in the Water Resources Council's 1983 Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies. All applicable laws, executive orders, regulations, and local government plans were

considered in evaluation of alternatives.[3] Based on this report, the reviews by other Federal, State and local agencies, Tribes, input of the public, and the review by my staff, it is my determination that implementing the recommended plan would not significantly affect the quality of the human environment; therefore, preparation of an Environmental Impact Statement is not required.[4]

_____ _____

Date

Scott Katalenich
LTC, Corps of Engineers
District Commander

[3] 40 CFR 1505.2(B) requires identification of relevant factors including any essential to national policy which were balanced in the agency decision.

[4] 40 CFR 1508.13 stated the FONSI shall include an EA or a summary of it and shall note any other environmental documents related to it. If an assessment is included, the FONSI need not repeat any of the discussion in the assessment but may incorporate by reference.

EXECUTIVE SUMMARY

The U.S. Army Corps of Engineers, Detroit District (USACE) has prepared this Integrated Feasibility Report and Environment Assessment (IFR/EA) to investigate the feasibility of beneficially using dredged material from Toledo Harbor, OH for ecosystem restoration purposes at Woodtick Peninsula, Monroe County, MI. The feasibility study is authorized under Section 204 (Beneficial Use of Dredged Material) of the Water Resources Development Act of 1992, Public Law 102-580, of the Continuing Authorities Program.

USACE is undertaking this action in partnership with the Michigan Department of Natural Resources (MDNR), the non-federal sponsor for the Section 204 project. This IFR/EA identifies a Tentatively Selected Plan for ecosystem restoration that is cost-effective and promotes National Ecosystem Restoration (NER) while protecting the nation's environment.

Woodtick Peninsula is in southeastern Michigan along the western shoreline of Lake Erie, in an area referred to as North Maumee Bay. The peninsula is located approximately 45 miles southwest of Detroit, Michigan, and, at its most southern point, 5 miles north of Toledo, Ohio. This study evaluates the feasibility of protecting, restoring and/or creating aquatic and ecologically related habitats, including wetlands, in connection with federal maintenance dredging at Toledo Harbor, OH.

USACE analyzed seven action alternatives and a No Action Alternative in this report for beneficially using dredged material at Woodtick Peninsula. The action alternatives propose several measures including in-water placement of dredged material adjacent to Woodtick Peninsula, upland placement of dredged material on the lakeside of Woodtick Peninsula, and the creation of offshore reefs using geosynthetic containers filled with dredged material. Alternative 4A (Figure ES.1) is identified as the Tentatively Selected Plan.

ES.1 In-water placement location for dredged material and offshore reef.

Alternative 4A includes in-water placement of dredged material from Toledo Harbor, OH on the leeside of Woodtick Peninsula. Dredged material would be hydraulically placed to an elevation of 570.75 feet. Dredged material would be placed at a 1:20 slope to bottom elevation of 562 feet. This action includes creation of an artificial reef made with geosynthetic containers (GSCs) that are filled with dredged material and have 6 to 8 inch diameter stone placed on top to form native fish habitat. The reef would be constructed off the southern end of Woodtick Peninsula. This

plan would have a placement footprint of 115.3 acres and require approximately 156,000 cubic yards (CY) of dredged material. Project first costs (FY22) are estimated at $5,529,000 and implementation would be cost shared with a federal contribution of $3,593,850 (FY22) and a non-Federal sponsor contribution of $1,935,150 . The non-Federal sponsor, the MDNR, supports the Tentatively Selected Plan, Alternative 4A, and has not proposed a locally preferred plan.

Implementation of the Tentatively Selected Plan for beneficial use of dredged material would not result in significant environmental impacts to water quality, existing wetlands, threatened and endangered species, terrestrial resources and habitat, aquatic resources and habitat, and other protected resources within the study area. Nor would it have any impacts to the local regional climate.

TABLE OF CONTENTS

Appendices

1 INTRODUCTION

The U.S. Army Corps of Engineers (USACE), Detroit District is investigating the feasibility of utilizing dredged material from the Toledo Harbor Navigation Project for beneficial use at Woodtick Pensinula located in Monroe County, MI. This report documents the planning process for the beneficial use of dredged material for the purposes of ecosystem restoration to demonstrate consistency with USACE planning policy, and to meet the regulations that implement the National Environmental Policy Act (NEPA). The following sections provide background information regarding the basis for this study.

1.1 STUDY PURPOSE AND NEED

This study evaluates the feasibility of protecting, restoring and/or creating aquatic and ecologically related habitats, including wetlands, in connection with the federal maintenance dredging at Toledo Harbor, OH. According to the Michigan Department of Environment, Great Lakes and Energy website, Great Lakes coastal wetlands have experienced 50 percent losses basin-wide and up to 90 percent loss in some areas (https://www.michigan.gov/egle). The need for continued maintenance dredging of the Toledo Harbor federal navigation channel, combined with the past loss of wetland habitat provides the opportunity to beneficially use Toledo Harbor sediments for ecosystem restoration purposes at Woodtick Peninsula.

1.2 AUTHORITY AND BACKGROUND

Section 204 of the Water Resources Development Act of 1992, Public Law 102-580, provides the authority to carry out projects to reduce storm damage to property, to protect, restore and create aquatic and ecologically related habitats, including wetlands, and to transport and place suitable sediment, in connection with dredging for construction, operation, or maintenance by the Secretary of an authorized Federal water resources project. It is a Continuing Authorities Program (CAP) authority which focuses on water resource related projects of relatively smaller scope, cost and complexity. Traditional USACE civil works projects are of wider scope and complexity and are specifically authorized by Congress. The CAP is a set of delegated authorities to plan, design, and construct certain types of water resource and environmental restoration projects without specific Congressional authorization.

1.3 LOCATION

The study area is located in Monroe County, Michigan. Woodtick Peninsula is in southeastern Michigan along the western shoreline of Lake Erie, in an area referred to as North Maumee Bay. The peninsula is located approximately 45 miles southwest of Detroit, Michigan and, at its most southern point, is 5 miles north of Toledo, Ohio (Figure 1). The pre-European settlement Woodtick Peninsula extended south from the shoreline as an unbroken barrier beach, 19,000 feet in length and between 1,200 to 2,600 feet in width (at its maximum). Today, due to long-term erosion and human modifications to the littoral environment, the peninsula is a series of islands separated by shallow channels. The peninsula is a fine sand feature that was apparently created

by littoral movements of sand from the north. In recent decades, shoreward migration of the peninsula and reduction in its size has been accelerated by high lake levels, erosion, breaching and probably starvation of sand sources from the north (Meadows, et al. 1992).

Woodtick Peninsula is located in an area with very shallow water depths for a considerable distance offshore. For instance, the shoreline has a 0.001 slope for several hundred yards into the lake. The range between low water datum and ordinary high water at Woodtick Peninsula range from 569.2 feet to 573.4 feet IGLD85, respectively. Depths offshore range from less than 1 foot to about 7 feet below LWD within the project area.

Other coastal conditions along the lakeside and leeside of Woodtick Peninsula differ in several ways. For instance, on the lakeside, extensive shoreline armoring to the north of the peninsula has severely reduced the sediment supply and corresponding littoral drift that once fed the peninsula. Sediment supply to the peninsula primarily came from the erosion of remaining bluffs, beaches and the nearshore to the north of the Woodtick Peninsula While the area lacks the significant wave energy of other Great Lakes coasts, reduced sediment supply coupled with record high water levels expose more of the peninsula to increased wave energy. This threatens not only the peninsula, but the large wetland habitats that are directly adjacent to Woodtick. On the leeside of the Peninsula, minimal sediment moves in the narrow channel in a north to south direction. Waves are on the leeside of the Peninsula, while on the lakeside significant wave heights are about 3 feet in height. This can change based on storm intensity and water levels. In general, the shallow nature of the area causes minimal wave action. Additional information about the coastal conditions of Woodtick Peninsula can be found in the Coastal Appendix (Appendix A).

The Woodtick Peninsula is a natural shoreline feature located within the Erie Marsh Preserve and Erie State Game Area. As recently as 1915 (based on historical maps), Woodtick Peninsula was more-or-less continuous along its entire 3.75-mile length and ranged from 500 to 1,500 feet in width for a total area of about 550 acres. Today, due to shoreline recession and erosion, the peninsula is comprised of a series of broken islands that are about 50% of its 1915 size. Erie Marsh, at 2,149 acres in size, is located west of Woodtick Peninsula, and represents 11% of the remaining marshland in southeastern Michigan and is one of the largest marshes on Lake Erie (Figure 2). The area also contains essential habitat for migratory birds. Thousands of ducks, geese, swans, shorebirds, and other birds utilize this area as an important stopover during their spring and fall migrations. The North American Waterfowl Management Plan has identified the western Lake Erie region as one of 34 unique habitat areas in the United States and Canada. The area is included as a Regional Shorebird Reserve by the Western Hemispheric Shorebird Reserve Network. Additionally, Woodtick Peninsula's shallow water habitat and associated coastal wetlands are important habitat for spawning, nursery, and feeding habitat for a wide variety of game fish and forage fish species which assist in making western Lake Erie one of the most attractive sport fishing areas in the Midwest.

Figure 1. Woodtick Peninsula Location

1.4 HISTORICAL AND FUTURE DREDGING OF THE TOLEDO HARBOR FEDERAL NAVIGATION PROJECT, OHIO

The Toledo Harbor Federal Navigation Project is a 25-mile-long Federal channel that must be maintained to authorized depths to support commercial navigation. The Federal project was first authorized in the Rivers and Harbors Act of 1899 and subsequently modified. There is an 18-mile Lake Approach Channel in Maumee Bay, which has authorized dimensions of 28 feet deep and 500 feet wide from the mouth of the Maumee River (Mile 0), through Maumee Bay to deep water in Lake Erie (Lake Mile (LM) 18). The Maumee River Channel is a seven mile-long channel in the lower Maumee River with has authorized dimensions between 25 – 27 feet and authorized widths ranging from 200 – 400 feet wide (Figure 3).

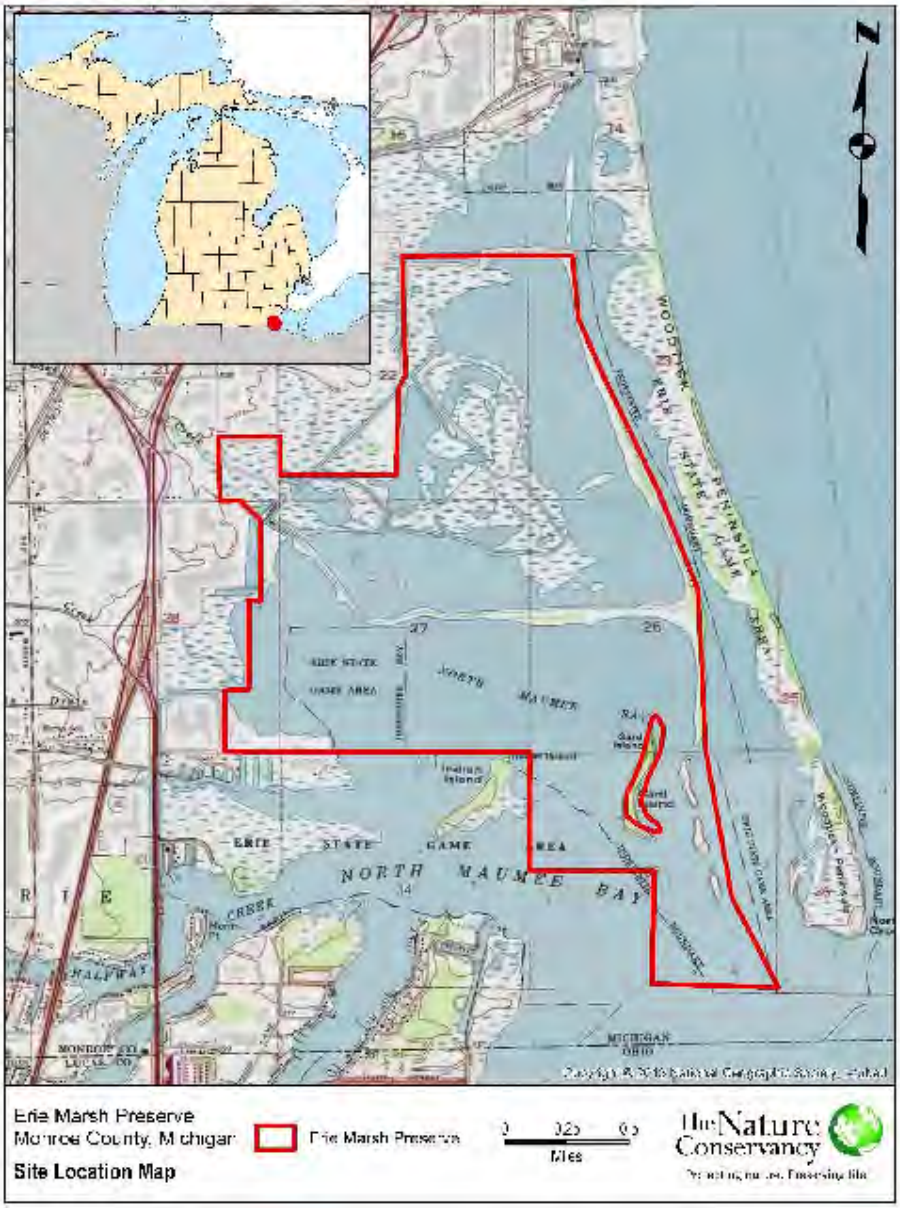

Figure 2. Erie Marsh located just west of Woodtick Peninsula

To keep the Port of Toledo operating, contractors for the USACE dredge approximately 400,000 – 1.1 million cubic yards of material annually. This amount varies by year based on target areas in the channel, lake levels and available funding. Table 1 provides historical dredging records for the Toledo Federal Navigation Project.

Table 1: Dredging Records for the Toledo Navigation Project

Year	Location	Dredged material volume (CY)	Dredged material placement location
2020	Maumee Bay	400,000	Toledo Port Authority Confined Disposal Facility (CDF)
2019	Maumee Bay	437,510	Open water placement site
2018	Maumee Bay	363,100	Open water placement site
2017	Maumee Bay	535,215	Open water placement site
2016	Maumee Bay	500,000	Open water placement site
2015	Maumee Bay	602,224	Open water placement site
2014	Maumee Bay	493,888	Open water placement site
2013	Maumee Bay	650,000	Open water placement site
2012	Maumee Bay	351,197	Open water placement site
2011	Maumee Bay	600,000	Open water placement site
2010	Maumee Bay	649,764	Open water placement site
2020	Maumee River	235,544	Toledo Port Authority Confined Disposal Facility (CDF)
2019	Maumee River	150,000	Open water placement site
2018	Maumee River	379,500	Open water placement site
2017	Maumee River	120,000	Open water placement site
2016	Maumee River	300,000	Open water placement site
2015	Maumee River	250,000	Open water placement site
2014	Maumee River	71,071	Open water placement site
2013	Maumee River	350,000	Open water placement site
2012	Maumee River	446,447	Open water placement site
2011	Maumee River	150,000	Open water placement site
2010	Maumee River	134,288	Open water placement site

Contractors primarily use mechanical dredging (with a clamshell bucket) for dredging the federal navigation channel. Historically, most of the sediments dredged from the Federal navigation channel are placed in the open lake location and a small amount are placed into the confined disposal facility (CDF). The designated open lake placement location is a two-square mile area northwest of Lake Miles 11-13. Toledo Harbor sediments are mostly finer grained material such as silts and clays.

Due to litigation with the State of Ohio in regard to open lake dredged material disposal, USACE started placing dredged material in the Toledo Port Authority's (CDF) in 2020. For the foreseeable future, it is assumed that dredged material will not be placed in the open lake placement site. The USACE Buffalo District manages the Toledo Federal Navigation Channel

and plans to dredge approximately 800,000 cubic yards of material in FY22 between Maumee Bay and Maumee River.

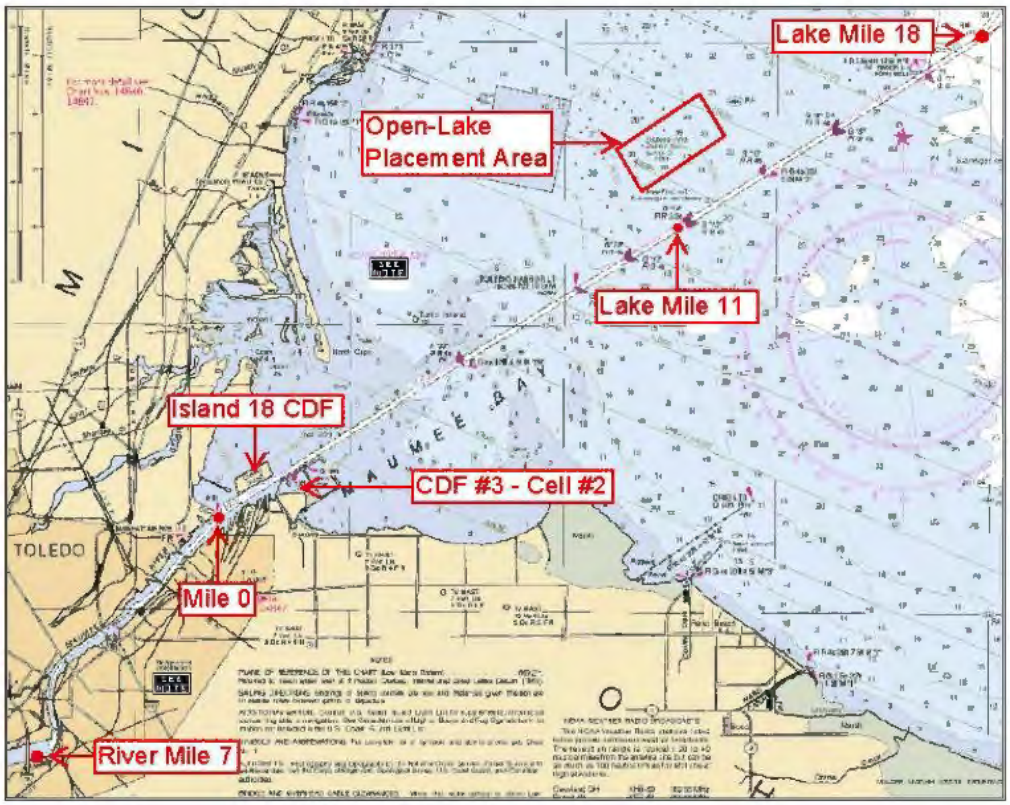

Figure 3. Toledo Harbor Dredging Operations

1.5 FEDERAL OBJECTIVE

The national or Federal Objective of water and related land resources planning is to contribute to National Economic Development (NED) consistent with protecting the nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements. Contributions to NED are increases in the net value of the national output of goods and services, expressed in monetary units. Contributions to NED are the direct net benefits that accrue in the planning area and the rest of the nation. The USACE objective in ecosystem restoration planning is to contribute to national ecosystem restoration (NER). Contributions to national ecosystem restoration (NER outputs) are increases in the net quantity and/or quality of desired ecosystem resources. Measurement of NER is based on changes in ecological resource quality as a function of improvement in habitat quality and/or quantity and expressed quantitatively in physical units or indexes (but not monetary units)
The Federal Objective of CAP Section 204 projects is to protect, restore and/or create aquatic and ecologically related habitats, including wetlands, in connection with the federal maintenance dredging at Toledo Harbor, OH.

The proposed project objectives and components were developed cooperatively by USACE (Detroit District), the Michigan Department of Natural Resources (MDNR), and other involved agencies and organizations.

1.6 RELEVANT PRIOR STUDIES AND REPORTS

Numerous studies and reports have been produced over the years relating to the changing landscape of the Woodtick Peninsula area. Several studies have included investigating the use of dredged materials from Toledo Harbor. Relevant studies include:

Erosional History and Management Alternatives of Woodtick Peninsula, Michigan (1982) – Published by the Detroit District, USACE, this study investigated physio-geological changes at Woodtick Peninsula since 1915. The study also made preliminary recommendations for beach restoration at Woodtick to protect coastal wetlands along the Michigan shoreline (USACE Detroit District, 1982).

Woodtick Peninsula Feasibility Study, Protection of Cooling Water Intake Channel, Consumers Power J.B. Whiting Plant (1989) – This study, conducted by the University of Michigan, prepared a preliminary design for protection of the J.B. Whiting coal-fired electrical generating plant, located just south of Luna Pier, Michigan. Prior to that time, the intake channel was apparently protected by the "uneroded" Woodtick Peninsula (Wright, 1989).

Coastal Monitoring Program and Shoreline Evolution Model, Year 4: Report B, Woodtick Point Peninsula, Michigan (1992) – Produced by the University of Michigan for the Michigan Department of Natural Resources, this study investigated deterioration of the Woodtick Peninsula, littoral drift in the area and potential methods for protection of Michigan coastal wetlands, particularly the suitability of using dredged materials to stabilize the Woodtick barrier island (Meadows *et al.*, 1992).

Preliminary Environmental Assessment for Beneficial Reuse of Toledo Harbor Dredged Sediments for Shoreline Protection (1999) - A preliminary environmental analysis of the feasibility of constructing and operating an offshore placement area at Woodtick Peninsula for dredged materials from Toledo Harbor, was prepared by Hull and Associates, for the Toledo-Lucas County Port Authority. This report looked at, in some detail, the environmental impacts of construction and operation of such a site (Hull and Associates, 1999).

Woodtick Peninsula Michigan and Toledo Harbor, Ohio Ecosystem Restoration and Protection Section 905(b) (WRDA 86) Analysis Reconnaissance Report (2004) – This report was produced by the USACE's Buffalo District to determine if there was Federal justification and interest in developing a plan for erosion reduction, navigation and ecosystem restoration at Woodtick Peninsula. The study considered several ecosystem restoration methods for Woodtick Peninsula and coastal wetlands, including using dredged materials from Toledo Harbor, Ohio.

2 AFFECTED ENVIRONMENT - EXISTING CONDITIONS

Existing conditions represent conditions at the time of report completion. Future conditions represent forecasted *future without project* conditions during the period of analysis, which is 50 years. The existing conditions descriptions contained in this section are the most relevant to the evaluation of project alternatives. Section 4.0 contains an analysis of the impacts from the alternatives on the resources described in this Section.

2.1 SOILS AND GEOLOGY

Lake Erie and southern Michigan are the result of glacial processes during the Pleistocene and Holocene (starting around 15,000 before present; Morang et al., 2011). In western Lake Erie, glacial drift during the Pleistocene led to the creation of a large proglacial lake extending over the southeast Michigan and northwest Ohio that led to the deposition of till (unsorted material deposited by glacial ice showing no stratification). In the years since the Pleistocene glacial retreat modern sediments consisting of sand, gravel, and shell have been deposited over the glacial till forming layers of variable thickness (Morang et al., 2011). The rock-derived portions of modern deposits come from upland sources (river and stream transport) and from erosion of bedrock outcrops exposed by glacial movement and the shell deposits are primarily from in-lake invertebrates, including a large input from zebra mussels since their invasion in 1987. Bedrock layers beneath the glacial deposits are mostly Devonian and Silurian limestone, shale, and Dolomite (Haack et al., 2005; Ohio Department of Natural Resources, 2018).

In modern times, the dredging of major tributaries to Lake Erie, including the Maumee River and Detroit River, has decreased the input of sand and gravel to western Lake Erie (Guy and Rockaway, 2004). This, combined with shoreline armoring (by private and commercial operations as well as urbanization) has turned a majority of Lake Erie into a sand-starved system (Ohio Department of Natural Resources, 2018). Combined with natural erosion, the reduction of sediment inputs to western Lake Erie has started to expose organic material on the lakebed and barrier beaches (Morang et al., 2011). A majority of this organic material is from wetlands (historical and extant) in southeast Michigan and northwest Ohio.

In 2021, a USACE survey team took surface grab samples of sediments surrounding Woodtick Peninsula. These sediments were found to be primarily sand and silt (approximately 50% and 37%, respectively) with lake-facing sampling sites having a higher proportion of sand (78% sand) and wetland/leeside sites having a higher proportion of silts and clays (~50% sand and ~20% clay). This indicates that the sediments surrounding Woodtick Peninsula are driven by both physical and biological processes. Lake-facing sides of the peninsula are subject to greater wave action and physical scour which resuspends and transports finer sediments, leaving behind larger grain sizes such as sands and gravels. The leeward side of the peninsula, on the other hand, is relatively protected from wave action and therefore has a larger amount of fine material from organic sources and the biochemical processes of the surrounding wetlands.

2.2 AQUATIC RESOURCES

2.2.1 Surface Water

The surface water of Lake Erie is considered to be impaired due to anthropogenic and climatic factors (Richards et al., 2010; Smith et al., 2015). The most notable factors are eutrophication due to agriculture in the Maumee River basin (IJC, 2013; Ouyang, 2005) and increased sediment loadings due to increases in spring precipitation, wet autumns, and early winters (Daloglu et al., 2012, Richards et al., 2010, Smith et al., 2015a, Stow et al., 2015, Watson et al., 2016).

Water impairments in western Lake Erie result in regular (annual) occurrences of harmful and nuisance algal blooms, including a bloom in 2014 that produced toxins as such levels that resulted in the loss of drinking water for over 400,000 residents of the City of Toledo, OH (Spear, 2014). These blooms are forecasted through a combination of phosphorus loadings to the Maumee River, and seasonal discharge to the river (NOAA GLERL: https://www.glerl.noaa.gov/res/HABs_and_Hypoxia/bulletin.html). Excessive algal biomass and sediment loads can also lead to hypoxia, which can further damage ecosystem function and aquatic life (Sekaluvu et al., 2018).

Multiple conservation efforts to improve water quality have been implemented, however no substantial changes in water quality have been observed likely stemming from anthropogenic and climatic changes not directly managed or emphasized through existing conservation efforts (Sekaluvu et al., 2018).

2.2.2 Groundwater

The sediments and underlying bedrock of Monroe County function as confining beds to groundwater for much of the county (Haack et al., 2005; Mozola, 1970; Nicholas et al., 1996). Groundwater in the Silurian/Devonian aquifers of Monroe County have lower dissolved oxygen and higher total dissolved solids (especially calcium, sulfate, and silica) than the surface waters of western Lake Erie (Haack et al., 2005). These aquifers have a high potentiometric surface that results in groundwater flow towards Lake Erie in the area near Woodtick Peninsula, however, the water table elevation is essentially flat in this area and piezometer data indicate that Lake level fluctuations and evapotranspiration influence the groundwater stage and head gradient; therefore, groundwater in this area has alternating flow towards and away from the Lake depending on Lake levels relative to groundwater stage (Haack et al., 2005).

Chemical analysis of nearshore water indicates that groundwater discharge to Lake Erie provides higher quality water to the immediate nearshore environment (Haack et al., 2005). These waters are richer in calcium, sulfate, and silica. The sulfate specifically provides a source of electrons for redox reactions, which play an important role in iron and phosphorus cycles and availability in western Lake Erie Waters (Haack et al., 2005).

2.2.3 Flood Plains

The Federal Emergency Management Agency (FEMA) maps Woodtick Peninsula as a special flood hazard area with a 1-percent-annual-chance to flood (FEMA, 2020). These areas have a 1-percent chance of having a 100-year flood occurring or being exceeded each year. FEMA uses the 100-year flood as the base flood for floodplain management. The base flood is developed considering storm event runoff and Lake Erie's storm surge and wave dynamics. The peninsula is mapped as likely to experience high-velocity flow, wave action, and erosion during a 100-year flood.

2.2.4 Wetlands

The Erie State Game Area and Erie Marsh Preserve to the west are identified wetlands in the Western Lake Erie Region in the North American Waterfowl Management Plan (USFWS, 1986). This area was designated as one of 34 unique habitat areas in the North American Waterfowl Management Plan (USFWS, 1986) and one of 43 areas of greatest continental significance to North American ducks, geese, and swans (USFWS, 2012). In September of 2000, Woodtick Peninsula and nearby wetlands were designated as a site of regional importance in the Western Hemisphere Shorebird Reserve Network (WHSRN, 2021). Erie Marsh, located to the west of Woodtick Peninsula, is 2,149 acres is size, represents 11% of the remaining marshland is Lake Erie, and is a conservation target for the restoration of Lake Erie (TNC, 2012).

In 2021, a USACE team evaluated the wetland habitat at Woodtick Peninsula using a Lacustuary Qualitative Habitat Evaluation Index (L-QHEI) approach (OEPA, 2010). This method was developed based on Lake Erie shoreline habitat types found in Ohio but is readily applicable to Woodtick Peninsula. This index provides a score from 0-100, with 100 being the best, based on five metrics of habitat: Substrate, cover types, shoreline morphology, riparian zone and bank erosion, and aquatic vegetation quality.

Woodtick Peninsula was evaluated using the L-QHEI assessed at 20 sites circling the peninsula spaced roughly 1600 feet (500m) on the leeward side and 3300 feet (1000m) on the lakeward side with the sampling occurring within 200-1000 (60 – 300m) feet of the shoreline..

The average score across all sites was 51, with a low score of 39 and a high score of 66.5. The average score of the leeward side was 47 and the lakeward side was 56. Leeward sites had lower quality substrate (average 7.6) but higher aquatic vegetation quality (average 4) scores. Lakeward sites had higher substrate (average 20) and near-zero vegetation scores (average 0.3) on account of those sites being a sand shelf with almost no vegetation at all. Given that the maximum score for aquatic vegetation quality is 30 points, the leeward wetlands had poor vegetation and L-QHEI scores in general. These indicate that Woodtick Peninsula supports two primary habitats, Lake Erie sandy shoreline (and associated sand/mudflats), and submerged wetlands with vegetation.

2.3 FISH AND WILDLIFE HABITATS

Woodtick Peninsula is a natural shoreline feature located within the Erie Marsh Preserve and Erie State Game Area. It consists of habitats classified as Great Lakes wetlands, coastal marshes, and open water of Lake Erie. These habitats are physically, biologically, and chemically connected to one another, providing interconnected resources for multiple vegetation communities and life stages of wetland and aquatic organisms.

2.3.1 Terrestrial and Aquatic Vegetation

The wetlands and coastal marshes of Woodtick Peninsula, and the surrounding area, has extensive stands of submergent and emergent aquatic vegetation (SAV and EAV, respectively). This includes wild celery (*Vallisneria americana*), sago pondweed (*Potamageton pectinatus*), American lotus (*Nelumbo lutea*), yellow pond lily (*Nuphar variegatum*), white water lily (*Nymphae odorata*), floating pond weed (*Potomogeton nantans*), coontail (*Ceratophyllum demersum*), pond lilies (*Nymphaeaceae*), water stargrass (*Zosterella dubia*), water milfoil (*Myriophyllum sp.*), and cattails (*Typha sp.*). SAV was observed along the leeward side of Woodtick Peninsula in shallow water areas extending roughly 2/3 the length of the peninsula during a site visit in June 2021. The depth increases towards southern end, which is also more exposed to open water and wave action from the lake, and no SAV was observed in this area.

Sites with SAV produced L-QHEI scores for aquatic vegetation quality ranging from 1-7 (out of 30). These scores were primarily driven by a relatively limited number of vegetation genera (maximum observed was four types), and uneven coverage of species present. At most sites only a single SAV type was commonly present.

Erie Marsh harbors some of Michigan's few remaining colonies of American lotus, which is listed threatened by the State of Michigan. Many of the emergent wetland areas are dominated by the non-native common reed (*Phragmites spp.*). The wet meadow habitat portions of Woodtick Peninsula include sedges, forbs, shrubs, and trees.

In addition to aquatic vegetation, western Lake Erie, including Maumee Bay and Woodtick coastal marshes, has primary production from phytoplankton occurring in the photic zone. Phytoplankton production in western Lake Erie marshes is much higher than in offshore areas (Herdendorf, 1987). The phytoplankton community includes diatoms, green algae, chrysophytes, cryptophytes, dinoflagellates, and cyanobacteria (Reavie et al., 2014). Cyanobacteria, in particular, have increased in density and biomass since the 1990s and become the dominant member of the phytoplankton community (Chaffin et al., 2014; Reavie et al., 2014). Certain species of these cyanobacteria are responsible for harmful and nuisance algal blooms in western upstream Lake Erie and Lake St. Clair (Meyer et al., 2017) and are capable of overgrowing or shading out benthic vegetation.

2.3.2 Fauna

Great Lakes coastal wetlands are habitat for fish, birds, invertebrates, reptiles, amphibians, and small to medium mammals. During a site visit in June 2021, the following were observed on Woodtick Peninsula or in the shallow nearshore waters surrounding the peninsula:

- Bald Eagle (*Haliaeetus leucocephalus*)
- Red-winged blackbird (*Agelaius phoeniceus*)
- Great Blue Heron (*Ardea herodias*)
- Mallard (*Anas platyrhychos*)
- Gulls (family *Laridae*)
- Muskrat (*Ondatra zibethicus*)
- Freshwater mussel (unidentified species)
- Turtles (unidentified species)

2.3.2.1 Fishes

Shallow water habitat and associated coastal wetlands at Woodtick Peninsula are important habitat for spawning, nursery, and feeding for a wide variety of native species (Wei et al., 2004) especially the warm water fish species of the lake, including northern pike (*Esox lucius*) and yellow perch (*Perca flavescens*; Francis and Boase, 2007). This is particularly true during the critical spring spawning periods when shallow water close to the peninsula warms earlier and is protected from extreme wave wash. Within the Great Lakes, 82 different fish species are either resident or migrate seasonally into coastal wetlands to use as nursery, spawning, or shelter habitat (Jude and Pappas, 1992).

Fish sampling in the study area has identified 35 fish species from 13 families; a majority of the fish sampled were white perch (*Monroe americana*), American gizzard shad (*Dorosoma cepedianum*), pumpkinseed (*Lepomis gibbosus*), and largemouth bass (*Micropterus salmonides*; Francis and Boase, 2007). Coastal wetlands along the Lake Erie shoreline are a natural part of the Great Lakes Ecosystem and are particularly valuable as spawning, feeding and nursery habitats for the warm water fish species of the lake. In particular, western Lake Erie coastal wetlands are the primary walleye (*Sander vitreus*) nursery area for all of Lake Erie, supporting a very important sport and commercial fishery (Herdendorf, 1992). The project area also serves as a transition point between coastal wetlands and the open waters of western Lake Erie. Fish communities in open-water and SAV habitats differ, with the SAV fish communities having a greater diversity and higher abundance of native species (Miller et al., 2018).

2.3.2.2 Invertebrates

The project area includes both submergent and emergent wetlands that adjoin the shallow western basin of Lake Erie and Maumee Bay. Invertebrate communities in this area therefore include benthic, planktonic, and terrestrial species. Across these communities, the most abundant macroinvertebrate genera are insects and crustaceans. However, despite overall diversity observed in Great Lakes marshes, a small number of taxa tend to be numerically dominant, with

10 taxa representing more than 60% of individuals collected in one survey (Cooper and Uzarski, 2016). This holds true across marshes dominated by native and non-native vegetation; all macroinvertebrate communities exhibited similar richness and community structure in native-dominated marshes and *Phragmites spp.*-invaded marshes (Robichaud et al., 2021).

Many freshwater mussel species are dependent on host fish for reproductive success, as fish serve as a stage of larval development and vector for dispersion (Goldsmith et al., 2021). As a result, the presence of native freshwater mussels in any given area is the result of reproductively viable populations and the occurrence of host fish species that are hydrologically connected to one another.

The benthic invertebrate community has undergone significant changes since the 1980s, primarily resulting from the introduction of non-native dreissenid mussels (zebra and quagga mussels; Soster et al., 2011). These mussels have shown the capacity to colonize all substrate types found in Lake Erie, including sand and mud (Berkman et al., 1998). Between 1988 and 1993 many of the dominant invertebrates decreased in abundance, being replaced with non-native dreissenids and *Hexagenia* (mayfly) nymphs. This led to changes in the trophic structure of the western Lake Erie ecosystem and a decrease in organic matter inputs to offshore, deep lake benthic habitat (Soster et al., 2011). Studies indicate that, in general, there is a higher invertebrate density and diversity in shallow water habitats (<2m; <6.5 feet) than in deeper or offshore waters (Shane et al., 2021).

2.3.2.3 Birds

In the Great Lakes, wetlands also serve as critical stopover habitat for migratory birds. Thousands of ducks, geese, swans, shorebirds, and other migratory birds utilize this area as an important stopover during their spring and fall migrations. Since the year 1993, 38 species of shorebirds (WHSRN, 2021) and 300 species of birds have been reported in Erie Marsh. Fall aerial surveys have estimated bluebill duck (*Aythya affinis*) populations as high as 50,000 birds at one time during November. Bald eagles (*Haliaeetus leucocephalus*) have been observed nesting and foraging on Woodtick Peninsula. Many dabbling ducks, shorebirds, and marsh-loving songbirds can be seen in Erie Marsh in March and early April as they rest and refuel on their way to northern breeding grounds for the summer. They will return to this site in the fall on their way back to their Central American and Caribbean winter homes.

2.3.2.4 Reptiles and Amphibians

Great Lakes wetlands support 55 species of reptiles and amphibians. Given that the species richness of reptiles and amphibians decreases with increasing latitude, the project area is with the range that hosts the greatest number of species (Sierszen et al., 2012). Many of these species are directly dependent on the health of wetlands, and indirectly influenced by anthropogenic development and its proximity to wetlands themselves (Sierszen et al., 2012). The presence of SAV is also an important habitat component as SAV creates microhabitats that can be exploited in different ways, and for different life stages of many reptile and amphibian species (Hecnar,

2004; Weiten et al., 2012). The presence of extensive stands of SAV and EAV at Woodtick Peninsula, the proximity of the Erie Marsh wetland complex, absence of vehicle roads and traffic, and the geomorphic configuration of the landmasses make Woodtick Peninsula wetlands more likely to support a greater richness and diversity of reptile and amphibian species (Hecnar, 2004; Weiten et al., 2012).

2.3.2.5 Mammals

Many mammals use coastal wetlands in the Great Lakes, however very few are obligate wetland species (require wetlands for survival and reproduction) and therefore not as responsive to changes in wetland abundance or health (Sierszen et al., 2012). The exception is the muskrat which is completely dependent on wetlands.

Muskrat generally have a small home range which they will defend, especially during breeding season (roughly March through September; Hygnstrom et al., 2014). It is common for muskrat to produce two or more litters of 4-8 young each year, allowing for within- and between-year dispersal and expansion of populations. They primarily feed on aquatic vegetation, but have been observed to also feed on crayfish, mussels, amphibians, and frogs if vegetation is scarce (Hygnstrom et al., 2014).

Muskrat were observed at Woodtick Peninsula during a 2021 site visit, indicating that this site possesses the necessary water depth, water quality, and vegetation to support muskrat. Given the small range sizes and number observed in the field, Woodtick Peninsula likely supports a breeding population capable of expansion.

2.3.3 Existing Terrestrial and Aquatic Habitats

Woodtick Peninsula is a Great Lakes marsh which contains three zones: southern wet meadow, emergent marsh, and submergent marsh (Cohen et al., 2020; Kost et al., 2007). In particular, Woodtick Peninsula is a lacustrine wetland with a primary configuration of a barrier-protected wetland that provides physical protection from Lake Erie while allowing water level and chemical influences. Great Lakes coastal marshes provide important structural habitat and primary production to support terrestrial and aquatic ecosystems (Jude and Pappas, 1992). Both Erie Marsh Preserve and Erie State Game Area are classified as Great Lakes marsh, with all three zones represented in various locations. This combination creates high-quality wildlife habitat that supports the highest species diversity of any Great Lakes ecosystem (TNC, 2012). This wetland habitat has a Global classification rank of G2 – Imperiled and a State Rank of S3 – Vulnerable due to their few occurrences, recent and widespread declines, and other factors making them particularly vulnerable (Albert, 2001; Cohen et al., 2020; Cummins et al., 2017; Kost et al., 2007).

East and southeast of Woodtick Peninsula is Lake Erie, the shallowest and most productive of the Great Lakes (Leach, 1993). The western basin of Lake Erie (west of a line drawn between Cedar Point, Ohio and Point Pelee, Ontario) is the shallowest portion of Lake Erie with a

maximum depth of 36 feet and has the heaviest sediment load (Allinger and Reavie, 2013). This basin of the lake is rarely stratified (i.e. it is well mixed), but when it does stratify tends to be associated with hypoxia (Allinger and Reavie, 2013.).

2.4 ENDANGERED AND THREATENED SPECIES AND THEIR HABITAT

2.4.1 Indiana bat

The Indiana bat (*Myotis sodalis*) is a small to medium-sized bat, weighing only one-quarter of an ounce that closely resembles other species of bat (most notably the little brown bat, *Myotis lucifugus;* Pruitt and TeWinkel, 2007). The Indiana bat was Federally listed as Endangered on 11.March.1967 wherever found. It is also listed in the State of Michigan as an Endangered Species. This bat hibernates during winter (approximately mid-October through mid-April) and after emerging roosts in a variety of tree species during summer. The Indiana bat prefers ash and dead trees, under slabs of exfoliating bark or within crevices and cracks (Pruitt and TeWinkel, 2007).

There is listed critical habitat for the Indiana bat (all hibernacula), but none in Michigan or northern Ohio (Pruitt and TeWinkel, 2007). There have not been any summer observations of the Indiana bat in Monroe County, though neighboring counties have reported observations in 2007.

2.4.2 Northern long-eared bat

The Northern Long-eared Bat (*Myotis septentrionalis*) is a medium-sized bat that hibernates overwinter (approximately August through May) and then emerges to forage for insects over water during the remainder of the year. When not hibernating, the northern long-eared bat will roost in large trees with loose bark or cracks and crevices. This bat shows some opportunistic tendencies in selecting roosts, using tree species based on suitability to retain bark or provide cavities or crevices and on rare occasions northern long-eared bats will roost in structures that have cracks and crevices that mimic those on trees (barns, sheds, etc.).

The northern long-eared bat was Federally listed as Threatened on May 4, 2015 wherever found. It is also listed in the State of Michigan as a Species of Special Concern. The Michigan Natural Features Inventory has not reported observations of the northern long-eared bat in Monroe County, but neighboring counties have reported observations and survey data may be incomplete (https://mnfi.anr.msu.edu/species/description/11427/northern-long-eared-bat).

2.4.3 Piping plover

Piping plover (*Charadrius melodus*) are migratory shorebirds that nest in northern breeding grounds in the spring on sandy beaches. The piping plover was designated a Federally endangered species on December 11, 1985 and is also listed as endangered in the State of Michigan. Critical habitat for this species in the Great Lakes, including Michigan and Ohio, was designated on May 7, 2011.

Piping plover typically use beaches with sand, gravel, and pebble substrate, and little to no vegetation. Open, sandy beach habitat is limited in Western Lake Erie due to urban growth, industrialization, erosion, and high-water levels. Piping plovers are in competition for use of the remaining habitat with other shorebirds, such as gulls, and with humans, who recreationally use sandy beaches and can disturb nesting and nests. Recover efforts coupled with continued competition for habitat has likely contributed to the observation that the number of non-nesting piping plover in the Great Lakes has increased since 2009, but the number of breeding pairs has declined and the survival rate during the first year of life is low (0.375±0.023; Stucker et al., 2003; Stucker and Cuthbert 2004; Westbrock et al., 2005; Cuthbert and Roche 2006, 2007a in USFWS 2009; Saunders et al., 2014; USFWS, 2020). In 2001, the USFWS designated critical habitat for the Piping Plover in Michigan (and other Great Lakes States), however none of these areas were in Michigan counties bordering Lake Erie (50 CFR Part 17). The closest designated critical habitat for Piping plovers to Woodtick Peninsula is the Sheldon Marsh States Nature Preserve near Sandusky, OH approximately 70 miles to the east/southeast.

2.4.4 Red knot

The red knot (*Calidris canutus rufa*, AKA Rufa Red Knot) is a migratory bird that may stopover on the shores of large lakes, such as Lake Erie. It was listed as threatened wherever found in 2015 and is being recommended for listing in the State of Michigan (Michigan DNR, 2015). These stopovers would be short in duration and involve feeding and resting before continuing to their final destination. Therefore, any red knot in Lake Erie would only be present on a seasonal basis for a short time frame.

This species does not have designated critical habitat, however in 2021 critical habitat was proposed from the species that did not include any of the Great Lakes or states boarding the Great Lakes (50 CFR part 17). In Michigan, the red knot has been seen in the lower peninsula at the Lake Erie Metropark to the northeast of Woodtick Peninsula (Sorg, 2017). The red knot is considered an uncommon migrant in Michigan so it is unlikely that red knot would be present in the project area let alone at all in western Lake Erie.

2.4.5 Eastern massasauga

The Eastern massasauga (*Sistrurus catenatus*) is a small to medium-sized rattlesnake found in wetland habitats throughout the Midwest, mostly in the lower peninsula of Michigan and northern Indiana and Ohio. It is Federally listed as Threatened wherever found and listed as a species of special concern in the State of Michigan. This species hibernates over the winter in crayfish and small mammal burrows, under logs, or in tree roots. Atypical for a rattlesnake, the eastern massasauga hibernates alone. Mating occurs in the late summer, with live birth occurring approximately one year later (so also in the late summer). Due to the timing, females may give birth every year or every other year.

In southern Michigan, massasauga populations are typically found in open wetlands, typically prairie fens. In many areas, massasaugas also use adjacent upland habitats. Prairie fen habitat is

not identified in the counties boarding Lake Erie and the last observation of a massasauga were in neighboring counties as recently as 2019 (Cummings and Mayer, 1992; Strayer and Smith, 2003).

Currently, there is no designated critical habitat for the eastern massasauga as the USFWS determined that any such designation may lead to increased persecution of the species (50 CFR part 17).

2.4.6 Northern riffleshell

The Northern riffleshell (*Epioblasma torulosa ragiana*) is a small to medium-sized freshwater mussel (up to 3 inches long) with a historical and present range in the lower Great Lakes/St. Lawrence River and Ohio River watershed (USFWS, 2019). This species was Federally listed as endangered wherever found on 22.Jan.1993 and is also listed as endangered in the State of Michigan. No critical habitat has been designated for this species.

The northern riffleshell was once widely distributed throughout its range but is now considered to be highly restricted in distribution, with localized populations that are not necessarily hydrologically connected. Of 54 streams once known to be occupied by the northern riffleshell, only 4 currently show populations with evidence of active reproduction, none of which are in Michigan (USFWS, 2019).

Typical habitat of the northern riffleshell is sections of rivers and streams with high water velocities and sand to gravel cover. A subspecies has been reported for Lake Erie (and Lake St. Clair) in deep water, however the Detroit River and Maumee River are considered to have extirpated or nearly extirpated populations (USFWS, 2019). No live individuals have been observed in these systems since 2012 (Ahlstedt 2009; Ahlstedt 2010; Ahlstedt 2011; Badra, 2009; EnviroScience 2012). These populations have been in decline since the introduction of zebra mussels (*Dreissena polymorpha*) in the 1980s and quagga mussels (*Dreissena bugensis*) more recently (USFWS, 2019).

The primary threats to northern riffleshell populations are anthropogenic in nature. Instream activities, such as dams, sand and gravel dredging, and bridge and pipeline construction cause direct and indirect physical disturbances to populations within and downstream of the affected area and can alter streamflow patterns and channel configuration. Land-based development within northern riffleshell population watersheds have led to a decrease in riparian habitat and increases in stormwater runoff, sedimentation, and sewage effluent. The northern riffleshell genus (*Epioblasma*) has been found to be especially sensitive to anthropogenic disturbances, in particular siltation, turbidity, and sewage effluent (Newton, 2003; Peacock et al., 2005).

2.4.7 Rayed bean

The freshwater mussel Rayed bean (*Villosa fabalis*) is a small (<1.5 inches long), oval-shaped mussel that had a considerable population within Lake Michigan, the lower Great Lakes, and the Ohio and Tennessee River basins (50 CFR part 17). The rayed bean was Federally listed as

Endangered wherever found on March 15, 2012 and is also listed as Endangered in the State of Michigan.

They rayed bean had a historical distribution in across 10 states including 115 streams, lakes, and man-made canals. It was considered both widespread and locally common throughout this range (50 CFR part 17). In Lake Erie, the rayed bean was common in the western basin, typically near to the islands in the western basin where sand and gravel substrate was present along with aquatic vegetation (such as water willow, *Justicia americana*, and water milfoil, *Myriophyllum sp.*) in or adjacent to riffles and shoals (West et al., 2000). Individuals are typically found buried within the root matrix of aquatic vegetation (Parmalee and Bogan, 1998) or attached to substrate particles via byssal threads (Woolnough, 2002).

In total, the rayed bean has been, or is considered, eliminated from 78% of its historical range (USFWS, 2002). While this decline in the lower Great Lakes system is less (62%) compared to the entire range's loss, the rayed bean population in Lake Erie, once classified as "considerable," especially in the western basin, has been considered "eliminated" since at least the year 2002 (USFWS, 2002). That last reported observation of a rayed bean in Monroe County, MI was 1984 (Burch, 1994). Of the 12 streams in the lower Great Lakes system where the rayed bean is still considered extant, none are geographically or hydrologically close enough to be considered a viable seed population for Woodtick Peninsula or the western Lake Erie basin (50 CFR part 17).

The introduction of the non-native zebra mussel is attributed to the elimination of the rayed bean from Lake Erie (USFWS, 2002). Zebra mussels attach to the shells of live mussels, preventing their locomotion, valve movement, valve shape, directly compete for food, and produce excess waste, all of which have negative impacts on native mussel species. Re-establishment and continued survival of the rayed bean, however, are presently threatened by anthropogenic loss and degradation of habitat (Neves, 1991). As a result of impacts to historical and current habitat, extant populations are small and geographically isolated, reducing overall genetic diversity of the species and preventing natural repopulation (USFWS, 2002).

2.4.8 Karner blue butterfly

The Karner blue butterfly (*Lycaeides melissa samuelis*) is a small butterfly with a wingspan of ~1 inch that is Federally listed as Endangered wherever found and State listed as Threatened. The Karner blue butterfly (KBB) has a historical distribution stretching from Massachusetts, through the lower Great Lakes and Wisconsin, and into southeastern Minnesota. Larval KBB feed exclusively on the wild lupine (*Lupinus perennis*), making the species' reproduction and survival entirely dependent on communities that contain wild lupine. Typically, this consists of natural oak or oak-pine savannahs or barrens, but in areas with human disturbance, KBB are more often found in openings, old fields, and rights-of-way that are adjacent to closed-canopy oak forests (MDNR, 2009).

According to the most recent 5-year review for this species, KBB have likely be extirpated from Illinois, Indiana, and Minnesota (USFWS, 2019). In Michigan there are approximately 3,900 acres in the western lower peninsula spanning 10 counties where the KBB and oak savannah habitat is known to occur; these areas have been divided into 4 Recovery Units according to the Federal Karner Blue Butterfly Recovery Plan (USFWS, 2003; MDNR, 2009). These Recovery Units do not encompass Monroe County or Lake Erie.

The last report of a KBB in southeast Michigan was in 1986 in Monroe County, following that report the KBB was believed to be extirpated from that portion of the state (MDNR, 2009). In 2008, the KBB was reintroduced to the Petersburg State Game Area, approximately 20 miles to the northwest, and inland, of Woodtick Peninsula.

KBB are not considered to be strong fliers, and typically limit their movements to a 6.2 acre area (USFWS, 2003). Individuals may range as much as 79 acres, however only a small subset of the population (usually <10%) will permanently leave their natal range (the habitat they hatched in; USFWS, 2003). This limits distribution of populations; in Michigan KBB are most likely to travel no more than 0.6 miles looking for additional high-quality habitat. Based on this information, it is highly unlikely that a re-established population at Petersburg State Game Area would have spread to Woodtick Peninsula.

Given the small dispersal potential of the KBB and its reliance on wild lupine, the KBB has been identified as particularly vulnerable to climate change (USFWS, 2019). A changing climate may impact either the KBB populations directly or indirectly through changing the range and health of wild lupine. As a result, some current or historical KBB habitats may be, or soon will be, unsuitable for KBB. In general, it appears that the KBB is most threatened by climate change in its southern range and may have been extirpated at the southern edge in recent history due to warming conditions (USFWS, 2019). These reports suggest that Woodtick Peninsula may already be, or soon occupy, the southern edge of a potential KBB range. The inability of the KBB to adapt to these changes, including its inability to adjust its range, may prevent any potential long-term expansion and re-introduction of the KBB to the project area without directed management strategies that are beyond the scope of this project.

2.4.9 Eastern prairie fringed orchid

The eastern prairie fringed orchid (*Platanthera leucophaea*; AKA prairie white-fringed orchid) is a perennial herb with a historical distribution throughout the lower Great Lakes and lower Midwest, with isolated populations in Virginia, Maine, and New Jersey (USFWS, 1999). This plant was federally listed as Threatened wherever found on September 28, 1989, and is also listed as Endangered within the State of Michigan. The eastern prairie fringed orchid is commonly found in prairie and wetland habitats but requires full sunlight for optimum growth and flowering, which restricts its distribution to plant communities dominated by grasses and sedges (as opposed to trees and other woody species; USFWS, 1999; Environment Canada, 2012). In Michigan the lake plains of Lakes Michigan, Huron, and Erie support appropriate

prairie habitat, which is primarily found in the southern and eastern parts of the lower peninsula. Along Lake Erie, the only known populations of adult eastern prairie fringed orchid are at Point Mouillee State Game Area, approximately 25 miles to the northeast of Woodtick Peninsula.

Seedling germination and growth, and therefore expansion and establishment of eastern prairie fringed orchid populations, is dependent on disturbance events within appropriate habitat (e.g. fire, grazing, timber cutting) to reduce plant competition or retard natural succession (USFWS, 1999; Environment Canada, 2012). In addition to its habitat requirements, this species is dependent on night-flying hawkmoths (Sphingidae) for pollination of its flowers that are fragrant at night (Bowles, 1983; Crosson et al., 1999; Cuthrell et al., 1999). Successful establishment of seedlings is dependent on the establishment of a mycorrhizal association with favorable soil-inhabiting fungi, which provides nutrients to the seedling while it develops underground for several years (Stoutamire, 1974).

Within western Lake Erie prairie habitat, populations of eastern prairie fringed orchid exhibit high levels of natural fluctuation, with disturbed areas being colonized within 2-5 years by orchids, but then a gradual decline after year 5 coinciding with succession/invasion by woody species, purple loosestrife, or reeds (USFWS, 1999).

There are no reports of the eastern prairie fringed orchid at Woodtick Peninsula, however at this site the presence of woody vegetation and common reed (*Phragmites australis spp.*) would limit the successful establishment of seedlings and pollination of adults. Land management strategies are an important tool for conservation of this species; however, no such land management actions occur on Woodtick Peninsula that would support viable populations (*Phragmites* control, burns, etc.).

2.5 RECREATIONAL, SCENIC, AND AESTHETIC RESOURCES

2.5.1 Local Resources

Woodtick Peninsula is almost entirely public, State of Michigan, owned land included in the Erie State Game Area. The peninsula offers recreation opportunities for local boating, fishing, and paddling enthusiasts. Access to the peninsula is only via water as a private company, Consumers Energy, owns the northern land access property. Monroe County can provide a list of access sites to reach Woodtick Peninsula.

A private organization, the Nature Conservancy, owns the Erie Marsh Preserve to the west of the peninsula. The Nature Conservancy opens the preserve during waterfowl hunting season to the Erie Shooting and Fishing Club and has significantly restored the land over the last two decades.

2.5.2 Regional Resources

Woodtick Peninsula is part of the Great Lakes and Midwest regions in the United States. Large cities and metropolitan areas along the Lake Erie shore include Cleveland, Ohio; Buffalo, New York; Erie, Pennsylvania; and Toledo, Ohio. Lake Erie offers many tourist locales to explore,

like shipwrecks, public parks and beaches, campgrounds, hiking and biking trails, and lighthouses. The western part of Lake Erie supports a significant tourism industry for the public to enjoy the offshore islands, with numerous ferryboat companies in operation.

2.6 CULTURAL RESOURCES

2.6.1 Cultural History

The earliest period of human habitation in the area, known as the Paleoindian Period (approximately 11,000 B.C. to 8,500 B.C.), followed Pleistocene glacial processes that formed the westernmost part of Lake Erie, including North Maumee Bay. Though glacial retreat began to drive environmental changes from a harsh to a warmer, more hospitable climate, limited abundance of animal and plant species following Pleistocene glaciation resulted small, highly mobile human groups that moved with resources throughout the region (Pratt, 1980 and Fredrick and Stricker, 2018).

This occupation pattern continued throughout the Archaic Period (approximately 8,500 to 500 B.C.), though the stabilizing climate introduced seasonal scheduling of habitation. Hunting techniques and technologies shifted to focus on smaller, more localized game and plant processing, with the majority of the sustenance coming from hunting deer and elk (Dragoo, 1976). By the start of the Middle Archaic Period and continuing through to the Late Archaic Period, the climate had generally stabilized to accommodate a temperate environment which allowed for increasing sedentary settlement patterns based on seasons as a driving factor of mobility rather than movement of game. By the Late Archaic Period, human settlement patterns show that groups would reoccupy the same system of sites on a semi-permanent and seasonal basis. The trend of more sedentary groups throughout the Archaic Period led to the addition of special purpose resource procurement and tool manufacturing as well as shifts in cultural traditions (Binford, 1980).

The stability achieved during the Archaic Period lent to the expected changes in occupation patterns with subsequent shifts in cultural practices. The Early Woodland Period (app. 500 B.C.-0 A.D.) saw more sedentary habitation patterns, evidenced by the development of domestication and resource processing, and an increase in territorialism. By the Middle Woodland Period (0-500 A.D.) human occupation was based on single, long-term habitation, with increased trade engagements, solidifying distinct cultural styles throughout the region. The western basin of Lake Erie where Woodtick Peninsula is located would been an environmentally diverse area with access to both a temperate environment and the maritime resources of Lake Erie (Stothers and Pratt, 1980).

By the Late Woodland Period (500- 1300 A.D.), spatial permeance established at this time led to intensified agricultural practices, coupled with supporting development of more extensive villages, forcing internal social reorganization to support changing labor needs. In the western Lake Erie region, the Late Woodland traditions are subdivided into phases based on ceramic

types: Gibralter (500-700 A.D.), Riviere au Vase (700-1000 A.D.), Younge (1000-1200 A.D.), and Springwells (1200-1300 A.D.) (Pratt, 1980).

It is around 600-700 A.D. that the Anishinaabeg people, living along the shores of Atlantic Ocean, began to migrate along the St. Lawrence River. As relayed by the story *Niizhwaaso-ishkoden Ningaanaajimowin* (the "Seven Fires Prophecy"), seven prophets told the Anishinaabeg that they would be led west by a vision of a great shell to a land where "food grows on water" (rice). They ultimately traveled up the St. Lawrence River and settled in the Upper Great Lakes, including the southeastern corner of present-day Michigan along the Lake Erie coast (Sinclair, 2012).

2.6.2 Previous Investigations

Woodtick Peninsula underwent archeological investigations by the University of Toledo in 1973-1978. These excavations also encompassed the surrounding Indian and Gard Islands, west of the peninsula within the North Maumee Bay. Most of the sites that were identified during these excavations were small, seasonally occupied camps near the lakeshore and were likely used as sites for fishing and resource processing before being taken inland to the main village. The sites were collectively concluded to represent the Riviere au Vase phase of the Late Woodland period (700-1000 A.D.), though there were indications of Archaic and historic occupation in the archeological record. Three sites were recorded on Woodtick Peninsula, all along the peninsula's eastern shoreline, and were reported to be remnants of satellite fishing sites (Pratt, 1980).

From these investigations, Woodtick Peninsula, in addition to Indian and Gard Islands, was added to the National Register of Historic Places (NRHP) as part of the North Maumee Bay Archeological District in 1980. The NRHP form notes that the sites present on Woodtick Peninsula and the surrounding islands have suffered from erosion due to raising water levels of the North Maumee Bay and Lake Erie, which has continued to the present-day (Pratt, 1980). In comparing recorded site locations on Woodtick Peninsula to the landform's current condition, it seems likely that continued shoreline erosion may have resulted in the destruction of the sites identified in the 1970's excavations. If these sites were not fully destroyed by erosion, there is potential that these sites might be either be extant underwater or material from these sites that would have eroded may have been redeposited along the shoreline as a result of the dynamic wave action. Considering the cultural history of the area, the density and significance of sites previously found in the archeological district, and lack of recent investigations on the peninsula there is significant evidence that there are still sites present or surviving materials from previously identified sites on or in the waters adjacent to Woodtick Peninsula that could be adversely affected by the proposed project.

In compliance with Section 106 of the National Historic Preservation Act (NHPA) and 36 CFR 800.4, in which a federal agency is responsible for identifying historic properties within the project's area of potential effect, the USACE is conducting a Phase I terrestrial and underwater

archeological survey for the Woodtick Peninsula landform and the water bodies adjacent to it to identify all archeological sites that may be impacted by the proposed project.

2.7 AIR QUALITY

Woodtick Peninsula is located in southern Monroe County, MI, less than four miles north of the City of Toledo, Ohio in Lucas County, OH. The EPA's archived U.S. Air Quality Index (AQI) data accessible via the Environmental Protection Agency's AirNow interactive maps show data for two stations in Lucas County dating back to late 2018. Since late 2018, these two stations' report Good to Sensitive daily AQI readings (EPA, 2018).

2.8 NOISE

Woodtick Peninsula is an unpopulated, publicly owned state game area. The U.S. Department of Transportation's National Transportation Noise Map for 2016-2018 mapped little-to-no air, rail, or vehicle transportation related noise on the peninsula. Because the peninsula is only accessible via water and is a popular fishing and hunting area, there is likely motorboat, hunting, and wildlife noises (Bureau of Transportation Statistics, 2018).

2.9 TOLEDO HARBOR DREDGED MATERIAL

The Toledo Harbor Federal Navigation Project is managed by the USACE Buffalo District. This material has been sampled and analyzed using appropriate methods according to the Great Lakes Dredged Material Testing and Evaluation Manual (USEPA/USACE, 1998), with sampling most recently taking place in 2012, 2014, 2015, 2016, 2017 (USACE, 2020), and 2021. The dredged sediment is composed of clays, silts, and some fine sands.

This project will use material taken from the Lake Approach portion of the channel, beginning near to Grassy Island and extending out into Lake Erie. This material is primarily clays (average 55%) and silts (average 33%) with some sand (average (14%). The source of the sediments dredged from the Federal Navigation Project is runoff of surficial fine-grain soils within the predominantly agricultural watershed of the Maumee River, as well as from the re-suspension of lake sediments in Maumee Bay and the western Lake Erie basin.

2.10 SOCIOECONOMIC AND ENVIRONMENTAL JUSTICE

Monroe County is located in Southeastern Michigan. It shares a border with three other Michigan counties. Wayne County lies to the North, Washtenaw County lies to the Northwest, and Lenawee County is directly West of Monroe County. It also shares a border with Lucas County, Ohio which is South of Monroe County.

The 2020 census shows Monroe County with a population of 154,809. This is an increase of 1.8% from the 2010 census and is 0.2% less than the growth rate in the State of Michigan. Monroe County has a population that is 94.3% white, 3.7% Hispanic or Latino, and 2.7% black or African American. This is less than the State of Michigan which is 79.2% white, 5.3% Hispanic or Latino, and 14.1% black or African American. There are additional races present in

both Monroe County and Michigan; however, their percentage of the total population are all below 5%.

Table 2. Demographics for Monroe County, MI and the State of Michigan

Metric	Monroe County, MI	Michigan
Population, Census, April 1, 2020	154,809	10,077,331
Population, Census, April 1, 2010	152,021	9,883,640
Population Change	1.8%	2.0%
White alone, percent	94.3	79.2
Black or African American alone, percent	2.7	14.1
Hispanic or Latino, percent	3.7	5.3
High school graduate or higher, percent of persons age 25 years+, 2015-19	91.4	90.8
Per capita income in past 12 months (in 2019 dollars), 2015-19	$31,481	$31,713
Persons in Poverty, percent	9.7	12.6

***Note:** For Race and Hispanic Origin, demographic populations with less than a 5% share of the total population were not included. Information obtained from www.census.gov .*

A majority of Monroe County residents aged 25 or older are high school graduates or have obtained some level of higher education (91.4%). This is compared to 90.8% for the State of Michigan.

The per capita income for Monroe County and the State of Michigan are very similar, $31,481 and $31,713 respectively (2019 dollars). Monroe County has a lower reported percent of people in poverty (9.7%) compared to the State of Michigan (12.6%).

2.11 CLIMATE

Lake Erie moderates Woodtick Peninsula's four distinct seasons. Summers are hot and humid, and winters are cold and snowy. Lake Erie typically freezes over each winter. Summertime warming can bring harmful algae blooms to southwestern Lake Erie. A qualitative climate change assessment for Woodtick Peninsula was conducted (Appendix F). The assessment describes observed and projected temperature and precipitation increases, along with potential climate change impacts to the project at Woodtick Peninsula.

3 PLAN FORMULATION

The guidance for conducting civil works planning studies, Engineering Regulation (ER) 1105-2-100, Planning Guidance Notebook, requires the systematic formulation of alternative plans that contribute to the Federal Objective. To ensure sound decisions are made with respect to alternative development and ultimately with respect to plan selection, the plan formulation process requires a systematic and repeatable approach. This chapter presents the results of the plan formulation process. Plan formulation was conducted in accordance with existing laws, regulations, policies, and the authorizing resolution, which limits the study to beneficial use of dredged material for ecosystem restoration projects. Section 204 of the WRDA of 1996 specifically limits the federal contribution to $10,000,000 or less per project. Alternatives were developed in consideration of study area problems and opportunities as well as study objectives and constraints with respect to the four evaluation criteria described in the Principles and Guidelines (completeness, effectiveness, efficiency, and acceptability).

The general objective of the feasibility study is to determine if there are engineeringly feasible measures and alternatives that would restore and enhance habitat through the beneficial use of dredged material, in the vicinity of Woodtick Peninsula, while increasing coastal resiliency. Ecosystem restoration projects must examine the condition of the existing ecosystems, or portions thereof, and determine the feasibility of restoring degraded ecosystem structure, function, and dynamic processes to a less degraded, more natural condition. Such activities are most likely to address ecosystems associated with wetland, riparian, and aquatic systems.

Plans to address ecosystem restoration are recommended based on their non-monetary benefits. These measures do not need to exhibit net national economic development (NED) benefits associated with traditional USACE economic analysis. Rather they are viewed based on non-monetary outputs, typically in terms of habitat output units. Plans selected for recommendation are then offered for consideration and budgetary support for their National Environmental Restoration (NER) outputs.

3.1 PROBLEMS AND OPPORTUNITIES

The problems for the study includes the following:

- Long-term erosion and human modifications to the littoral environment have contributed to a loss of high-quality wetland and aquatic habitat on Woodtick Peninsula and the adjacent aquatic area.

The opportunities for the study include the following:

- There is an abundance of available sediments from the Toledo Harbor Federal Navigation Project for beneficial re-use. Between 2010 through 2020 on average

510,000 cubic yards of dredged material were removed from Maumee Bay which is part of the Toledo Harbor Federal Navigation Project

- There is the potential to enhance coastal resiliency through reducing erosion and stabilizing the shoreline along Woodtick Peninsula.
- There is public and state agency interest and support of restoration efforts in the Woodtick Peninsula area, allowing all to benefit from this partnership There is a potential to enhance recreational opportunities in the study area.
- There is opportunity to create coastal wetlands, sub-merged aquatic habitat, and restore the Lake Erie ecosystem.
- There is an opportunity to reduce erosion and to provide limited shoreline protection benefits to Woodtick Peninsula.

3.2 OBJECTIVES AND CONSTRAINTS

3.2.1 Planning Objectives

The planning objective for the study include the following:

- Beneficially use dredged material from Toledo Harbor at Woodtick Peninsula for the purpose of aquatic ecosystem restoration including the creation of coastal wetlands, submerged fish habitat, and other aquatic habitats over the planning period of 2025 to 2075.

3.2.2 Planning Constraints

The following constraints have been identified for the study:

- Any dredged material used for the project must meet State of Michigan water quality standards.
- The project cannot exacerbate invasive plant species colonization (specifically Phragmites spp.)
- Numerous bald eagle nests are located on Woodtick Peninsula and the Lake Erie side of the Peninsula is a recognized walleye fishery. Project implementation cannot negatively disrupt these sites.
- Avoid impacts to recreational boat access around Woodtick Peninsula.

3.3 MOST PROBABLE FUTURE WITHOUT PROJECT CONDITIONS

Under the future without project condition, it is assumed that no Federal action would be taken to beneficially use dredged material from Toledo Harbor for ecosystem restoration in Michigan. Instead, it is expected that the annual maintenance dredging of Toledo Harbor would continue with the quantity dredged determined by available funding. In absence of a federal project, conditions at Woodtick Peninsula and its associated habitats would be expected to decrease in size and continue to be degraded by wave driven erosion.. Woodtick peninsula is likely to continue to experience erosion thereby reducing the already limited aquatic, submergent, and

emergent wetland habitat in the vicinity. Invasive species, especially Phragmites spp. are expected to continue to colonize any suitable area consistently above water.

Through the rest of the 21st century, the Great Lakes region is expected to be impacted by climate change effects, including higher-intensity storms and more variable weather conditions. These changes are expected to cause more intense hydrologic conditions (both wetter and dryer) across the region, leading to potentially larger ranges of lake levels, heavier precipitation events, increased flooding and river flows, and stronger storms causing higher waves. These changes could further damage this environmentally valuable area, resulting in the reduction or loss of key Great Lakes habitat.

3.4 MEASURES TO ACHIEVE PLANNING OBJECTIVES

Management measures are features or activities that can be implemented at a specific geographic location to address one or more planning objectives and avoid constraints. A preliminary list of management measure categories and how they apply to Woodtick Peninsula is included below:

- Rebuild Peninsula/Rebuild wetlands with dredged material placement - – This measure includes placing material in water with the intent of keeping the material submerged for wetland (submerged aquatic vegetation) creation or upland placement above the ordinary high-water mark. This measure includes placement in areas adjacent to Woodtick Peninsula.
- Channel restoration – channel restoration refers to placing dredged material into an old shipping channel located along the leeside of Woodtick Peninsula. This shipping channel used to be dredged to a depth of approximately 15 feet in order for coal barges to reach a powerplant. The powerplant has since closed and the channel is no longer maintained. Placing dredged material in the shipping channel could aid in wetland restoration of the area.
- Beach nourishment – Placing suitable dredged material on and adjacent to the existing shoreline to create a beach.
- Containment methods – A wide range of containment structures were discussed to include segmented or continuous, above or below water, rubble-mound barriers. Other types of containment options included the use of temporary silt curtains, steel sheet piling, bioengineered structures, or the use of woody debris. These were considered in case the dredged material needed to be contained due to the fine grain nature of the material due to concerns about the material washing away from Lake Erie wave action.
- Habitat enhancement methods – Measures to improve habitat that were considered include invasive species removal (phragmites removal), native planting, and natural establishment.
- Nearshore Breakwaters – detached structures parallel to the shore used to reduce wave energy.
- Groins – perpendicular structures used to restrict longshore sediment transportation.

- Stone Islands filled with dredged material – This measure includes placing dredged material in a series of islands, surrounded with stone along the lakeside portion of Woodtick Peninsula.
- Culvert – This measure would place a culvert at the northern edge of Woodtick Peninsula in order to increase the hydrologic connectivity between the lakeside and leeside portions of the peninsula.
- Geosynthetic containers (GSCs) – GSCs are essentially large bags made out of industrial strength fiber and were considered in place of stone for features such as offshore reefs. These containers would be filled with dredged material and placed on the lakebed. Small rock (such as limestone with a diameter between 6 – 12 inches) would be used to place on top of the GSCs in order to create native fish habitat

3.5 SCREENING

Screening is the process of eliminating, based on planning criteria, those measures that will not to be carried forward for further analysis. ER 1105-2-100 states that "each plan shall be formulated in consideration of four criteria described in the P&G: completeness, efficiency, effectiveness, and acceptability. The four criteria were considered for these initial measures screening effort with a focus on efficiency, effectiveness, and acceptability. The P&G planning criteria is further described in Section 3.7. For the initial screening of measures, criteria are derived for the specific planning study based on the planning objectives and constraints of the study and study area. Criteria used to screen measures as well as qualitative metrics associated with each criterion include the following (Table 3):

- Does the measure include the use of dredged material (meets primary planning objective)? (Yes/No); measure is screened out from further analysis if response is "No".

- Is the type of dredged material available suitable for use with the measure? (Yes/No); measure is screened out from further analysis if response is "No".

- From an environmental and public standpoint, is the measure acceptable? (Yes/No); measure is screened out from further analysis if response is "No".

- Does the measure meet the planning objective to restore habitat and increase quantity and quality of habitat? (Yes/No); measure is screened out from further analysis if response is "No".

- Are the costs associated with the measure likely to be within the Section 204 cost limits ($10 million Federal)? (Yes/No); measure is screened out from further analysis if response is "No".

Table 3: Measures Screening

	Use of Dredged Material	Suitability of Dredged Material	Acceptability (public and environmental)	Meets objectives to restore habitat and increase quantity and quality of habitat	Costs likely to be within Sec 204 cost limits?	Carried forward?
Channel Restoration (fill in old channel with dredged material)	Yes	Yes	Yes, with constraints	Yes	**Yes**	**Yes**
Rebuild wetlands/Rebuild peninsula -Segmented or continuous below water rubble mound -containment – woody debris or bioengineered structure -invasive species treatment	Yes	Yes	Yes	Yes	**Yes**	**Yes**
Near shore placement of dredged material (beach nourishment)	Yes	No	No	No	**Yes**	**No**
Nearshore breakwaters	No	No	No	No	**No**	**No**
Nearshore breakwaters + dredged material	Yes	No	No	No	**No**	**No**
Lakeside stone islands filled with dredged material	Yes	Yes	Yes	Yes	**No**	**No**
Lake side groins	No	No	No	No	**No**	**No**
Groin at southern end + dredged material	Yes	Yes	Yes	Yes	**Yes**	**Yes**
Geosynthetic Containers filled with dredged material (artificial reef)	Yes	Yes	Yes	Yes	**Yes**	**Yes**

Based on the screening summarized above, beach nourishment, nearshore breakwaters, nearshore breakwaters with dredged material placement, and groins were screened from further analysis. Dredged material from Toledo Harbor contains minimal amounts of sand and is not suitable for a beach nourishment type project. Nearshore breakwaters and groins by themselves would not meet the primary planning objective to utilize dredged material. Dredge material placement on the lakeside of Woodtick peninsula was eliminated due to the concerns about the negative impacts of wave action on the dredged material. Encapsulating dredged material with stone to essentially form a series of stone islands was considered, but estimated costs would exceed the CAP Section 204 project limit so the measure was screened from further consideration.

Therefore, the following measures were carried forward for additional analysis:

- Channel restoration (Dredged Material Placement)
- Rebuild wetlands/rebuild peninsula (Dredged Material Placement)
- Geosynthetic containers to form an artificial reef

3.6 FORMULATION OF THE ARRAY OF ACTION ALTERNATIVES

Alternatives are a set of one or more management measures functioning together to address one or more planning objectives. An initial array of alternative plans was formulated based on information provided by the Michigan Department of Natural Resources combined with engineering judgment provided by the Detroit District. Several assumptions were made in the development of the alternatives and are described in the section below.

Dredged Material

It was assumed that all dredged material would come from the Toledo Harbor Navigation Project and is suitable for in-water placement. This material is mostly silt and fine-grained material with minimal sand. For the initial array of alternatives, the PDT attempted to use a full dredging cycle of material representative of a Maumee Bay dredging cycle (approximately 400,000 cubic yards see Table 1 in Section 1.4 for historical dredging records). However, due to placement costs associated with the shallow nature of the area, and the CAP Section 204 cost limits, it was not possible to use a full cycle of dredge material and stay within the CAP Section 204 project cost limits.

Placement depth

The invasive species, *Phragmites spp.*, is a concern on Woodtick Peninsula. This hard to manage and hard to eradicate plant has colonized much of Woodtick Peninsula. In order to minimize it's spread it was assumed that all in-water dredged material placement would be approximately six inches below the average water depth of Lake Erie (570.75 feet). In this way, it could reasonably be assumed that the surface of the placed material would be underwater for at least half of an average year, considering the annual rise and fall of Lake Erie water levels. Phragmites spp. cannot colonize in areas with six or more inches of water. Another placement depth assumption relates to recreational boating in the area. On the leeside of Woodtick Peninsula a 12 foot channel exists that used to be maintained by an energy company (Consumer's Energy). This is because they had a power plant just north of Woodtick Peninsula and ships with coal for the power plant would use the channel. The power plant has since closed, and the channel is slowly starting to fill in. It is a popular spot for recreational boating related to fishing and hunting. As placement depths were determined it was important to the NFS to keep a minimum of 3 feet of water depth for part of the channel for recreational boaters. This assumption was built into the alternative development.

Restore the Historical Footprint of the Peninsula

Historical photographs were examined of Woodtick from the last 75 years. Over this time period much of the erosion and degradation has occurred at the southern end of the peninsula and part of the lakeside. The PDT focused alternative development on the southern end of the peninsula and on part of the lakeside where the most significant erosion had taken place.

Focus on areas of degradation

The Lake Erie Qualitative Habitat Evaluation Index (L-QHEI) developed by the Ohio Environmental Protection Agency is designed to provide a measure of Lake Erie shoreline habitat quality that generally corresponds to those physical and biological factors that affect fish communities, and which are generally important to other aquatic life (e.g. invertebrates). The L-QHEI consists of five metrics based on shoreline habitat quality: (1) substrate type/quality; (2) cover type; (3) shoreline morphology; (4) riparian zone and bank erosion; and (5) aquatic vegetation quality. L-QHEI sampling occurred in the Woodtick Peninsula study area. The PDT focused on developing alternatives that enhanced areas with the lowest L-QHEI scores. This was mainly near the southern end of the peninsula on the lee side.

3.7 FINAL ARRAY OF ALTERNATIVES

Several iterations of alternatives occurred for this project. A key challenge was to design alternatives that could stay within the Section 204 CAP authority cost limits ($10 million Federal/$5 million non-federal). Through several PDT mtgs and in conjunction with the NFS, a final array of alternatives was developed. The final array of alternatives includes seven alternatives (a future without project condition/no action alternative and six action alternatives). These are described below.

3.7.1 Alternative 1: Future Without Project Condition (FWOP)/No Action Alternative

The FWOP condition, analyzed for comparison with the action alternatives assumes no Federal Action to beneficially use dredged material at Woodtick Peninsula (Figure 4). For purposes of NEPA, it represents the No Action Alternative (NAA) for the proposed project. Alternative 1 would consist of continuation of the current dredged material placement practice from the dredging of Toledo Harbor, OH which consists of disposal into a Confined Disposal Facility (CDF). No placement of dredged material would occur near or on Woodtick Peninsula. Under this alterative, erosion is expected to continue along Woodtick Peninsula, especially near the southern end where exposed land is present. Phragmites would continue to colonize the peninsula. An old commercial channel exists along the leeside of Woodtick peninsula that was once maintained and used by a power plant company. Ships bringing coal to the power plant would use the channel and the power plant company maintained the channel. The power plant has since closed, and the channel is no longer maintained. It has depths of between 12 and 15 feet and is slowly filling in. In the NAA, it is assumed that any future dredging of the channel will not occur, and the channel will slowly fill in.

Also, the Great Lakes basin has already seen evidence of climate change as more intense storms result in more frequent and damaging floods, interspersed with lengthy periods of dry weather, as well as increasing lake water temperatures and reduced amounts and duration of ice cover in winter. Near-record high water levels have contributed to significant erosion throughout the Great Lakes, including Lake Erie. This has undoubtedly contributed to a period of greater-than-average erosion of Woodtick Peninsula. It is expected that the NAA will leave the peninsula further vulnerable to climate change and its erosive forces into the future.

Figure 4. No Action Alternative (Alt. 1)

3.7.2 Alternative 2A and 2B – Rebuild Peninsula and Channel Restoration

Alternative 2A and Alternative 2B includes placing dredged material from Toledo Harbor, OH on the lee side of Woodtick Peninsula (west of the Peninsula). Dredged material would be hydraulically placed to an elevation of 570.75 feet (Figure 5 and Figure 6). This is below the long-term average water depth of Lake Erie (571.42 feet). At this placement elevation, it is assumed that dredged material would be under at least six inches of water for at least 50% of the year, considering the seasonal rise and fall of Lake Erie. The low water datum for Lake Erie is currently 569.2 feet. Keeping the dredged material submerged for 50% or more of the year will discourage phragmites spp. colonization while creating submerged wetland habitat suitable for SAV. Dredged material would be placed at a 1:20 slope to bottom elevation of 562 feet. A key constraint for Alternative 2A and 2B is ensuring access around the peninsula for recreational boaters. This is achieved by sloping dredged material starting at the Peninsula away to an elevation of 562 feet near the far edge. This will allow a small part of the channel to remain at a depth between 3-7 feet. It is assumed this part of the channel would be too deep for submergent wetlands to establish and thereby recreational boaters can access the large water body north of Woodtick Peninsula. The main form of recreational boating in the area relates to duck hunting and fishing.

In Alternative 2A, dredged material would not extend beyond the old channel. In Alternative 2B, the old channel would be filled to a depth of 570.75 feet, extending to the shallow area just to the west of Woodtick Peninsula. It is assumed that recreational boaters would have to access the old channel near the middle of Woodtick Peninsula. Alternative 2A would have a placement footprint of 129 acres and require approximately 245,500 CY of dredged material. Alternative 2B would have a placement footprint of 142 acres and require approximately 388,000 CY of dredged material.

Figure 5. Alternative 2A

Figure 6. Alternative 2B

3.7.3 Alternative 3 – Rebuild Peninsula + Channel Restoration + Lakeside Reef

Alternative 3 includes placing dredged material from Toledo Harbor, OH on both sides of Woodtick Peninsula (Figure 7). Dredged material placed on the leeside of the peninsula will create approximately 129 acres of submerged wetland habitat for SAV by increasing the bottom elevation to bring a larger area into the photic zone capable of supporting photosynthesis. Dredged material placed on the lakeside will create approximately 40 acres of emergent wetland habitat by raising the bottom elevation above the Ordinary High Water Mark (OHWM) for Lake Erie (IGLD 1985). The creation of an artificial reef on the lakeside will provide approximately 11.5 acres of hard-bottom fish habitat. In the leeside placement area, dredged material would be hydraulically placed to an elevation of 570.75 feet closest to the peninsula and slope out at a 1:20 slope to a bottom elevation of 562 feet. This placement area would not extend beyond the old leeside channel for a dredged placement footprint of approximately 129 acres. This placement elevation is designed to maintain at least six inches of water for at least 50% of the year which will discourage phragmites spp. colonization while creating submerged wetland habitat suitable for SAV. Leeside placement would create submerged wetland habitat suitable for SAV. On the lakeside of the peninsula, dredged material would be placed to an elevation of approximately 574 feet within a 40-acre footprint to create emergent wetland habitat. No phragmites removal is expected prior to dredged material placement in this area. After placement, plantings with native emergent wetland species would occur along with phragmites control methods to ensure phragmites does not colonize the placement area. Offshore, from the lakeside placement area, an artificial reef would be created with geosynthetic containers (GSCs) filled with dredged material and covered with rip rap. These containers would be placed in roughly a rectangle shape to an elevation of approximately 566.2 – 566.5 feet. Stone rip-rap would be placed on top of the GSCs to create fish and wildlife habitat. For GSCs placed on the lakeside of Woodtick Peninsula, it is likely the rip-rap would be above water for a majority of the year. The GSCs would have a footprint of approximately 11.5 acres and require approximately 13,500 CY of dredged material. Overall, the lakeside placement area would require 10,500 CY of dredged material and the leeside placement would require 245,500 CY of dredged material. For Alternative 3 as a whole, approximately 270,000 CY of dredge material would be required between the three features (leeside placement, lakeside placement, and reef construction).

Figure 7. Alternative 3

3.7.4 Alternative 4A and 4B – Rebuild Peninsula at Southern End of Peninsula and Offshore Reef

Alternative 4A and 4B includes placing dredged material from Toledo Harbor, OH on the leeside of Woodtick Peninsula to create submerged wetland habitat for SAV by increasing the bottom elevation so that a larger area is within the photic zone and the construction of an artificial reef at the southern terminus of the peninsula to create fish habitat (Figure 8 and Figure 9). Dredged material would be hydraulically placed to an elevation of 570.75 feet with a 1:20 slope to a bottom elevation of 562 feet. It is assumed that this elevation will provide at least six inches of water for at least 50% of the year and will discourage phragmites spp. colonization while creating submerged wetland habitat suitable for SAV. Alternative 4A would not extend placement past the old channel, while alternative 4B would extend the dredge placement footprint to include the entire old channel. Alternatives 4A and 4B include the creation of an artificial reef made with geosynthetic containers filled with dredged material and covered with rip rap at the southern end of Woodtick Peninsula. These containers would be placed in roughly a curved line to an elevation of approximately 566.2 – 566.5 feet. Stone would be placed on top of the GSCs to create fish and wildlife habitat. Stone sizes would range from 6-12 inches with some larger 3-feet diameter stone. For the reef placed at the southern end of Woodtick Peninsula, it is likely that a portion of it would be above water for a majority of the year. The reef would be approximately 1,200 feet in length, have a footprint of approximately 1/3 of an acre, and require approximately 1200 CY of dredged material. Alternative 4A would create 115.3 acres of submerged wetland and require approximately 156,000 CY of dredged material. Alternative 4B would create 116.3 acres of submerged wetland and require approximately 329,000 CY of dredged material.

Figure 8. Alternative 4A

Figure 9. Alternative 4B

3.7.5 Alternative 5 – Rebuild Peninsula at Southern End of Peninsula and two offshore reefs

Alternative 5 includes all features from Alternative 4A, plus the lakeside placement area and offshore reef from Alternative 3 (Figure 10). This alternative will create approximately 115.3 acres of submerged wetland habitat, 40 acres of emergent wetland habitat, and 12 acres of reef habitat for fishes. Alternative 5 would have a dredged material placement footprint of approximately 167 acres and require 353,000 CY of dredged material for the four features (leeside placement, lakeside placement, lakeside reef, and reef at southern end). This would create submergent and emergent wetland habitat in addition to hard substrate reef habitat.

Figure 10. Alternative 5

3.8 FORMULATION AND COMPARISON OF ALTERNATIVE SOLUTION SETS

Alternatives related to the proposed action at Woodtick Peninsula modifications were evaluated under the Principles and Guidelines formulation criteria, the four accounts evaluation framework, risks and uncertainties were examined, and the achievement of objectives and avoidance of constraints.

3.8.1 Cost of Alternatives

Parametric level costs for construction of all alternatives were developed and are based on recent construction cost data for similar work features. Total Project Cost Spreadsheets (TPCS's) were used to estimate costs for planning, engineering, design and construction management for each alternative, as well as applying escalation to the mid-point of construction in Q4 2024. Construction costs include a 30% contingency.

Under the Section 204 Authority, costs of beneficial use of sediment projects are limited solely to construction costs that are in excess of the Base Plan or Federal Standard. As a result, the costs used for evaluation and comparison purposes are the incremental costs of the potential ecosystem restoration plans over the cost associated with disposing of the sediments as described in the Base Plan. The base plan costs include cost of mobilization/demobilization, dredging of the sediments, and transportation and placing of the sediments at the designated placement area. These costs were developed by the Detroit District Cost Engineering Team based on recent dredging operations at Toledo Harbor. Since the alternatives are likely to use mechanically dredging and then hydraulic placement due to the shallow nature of the waters around Woodtick Peninsula, dredging costs from similar Duluth Harbor, MN projects were also examined. Several beneficial use of dredged material projects for the purpose of ecosystem restoration have occurred in the Duluth Harbor and were used to develop the cost estimates. The base plan costs were determined to be $4.00 per cubic yard.

3.8.2 Ecological Output Analysis of Alternatives

Many methods are available to measure current ecosystem resource conditions and to predict the future conditions of those resources. Habitat values for the with and without project conditions for each alternative were determined by conducting the Lake Erie/Lacustuary Qualitative Habitat Evaluation Index (L-QHEI) developed by the Ohio Environmental Protection Agency (OEPA; OEPA, 2010). A full discussion of the ecological outputs for each alternative is provided in Appendix D.

The L-QHEI consists of five metrics based on shoreline habitat quality: 1) substrate 2) cover type, 3) shoreline morphology, 4) riparian zone and bank erosion, and 5) aquatic vegetation quality. The L-QHEI scores were calculated and recorded on an L-QHEI field sheet (Appendix D at 20 sites surrounding Woodtick Peninsula during a site visit conducted in June.2021. Each site has a score calculated from the five metrics between 0 and 100 (low scores represented low habitat quality/high human disturbance and high scores indicated high habitat quality/little

human disturbance). To assess the future condition with restoration, L-QHEI scores were predicted that could be attained at the completion of each restoration alternative. This was done by examining restoration alternative proposal narratives and plan drawings and estimating L-QHEI scores based on the proposed specifications (Table 5).

Table 4. Cost summary of alternatives

Alternative	Dredged Material Quantity (CYD)	TPCS (total project cost summary/ base plan costs excluded)	Base plan costs (excluded from total project cost summary)
Alt. 1 – No Federal Action	-	-	
Alt 2A – Rebuild Peninsula	245,500	$ 8,423,000	$ 982,048
Alt 2B – Rebuild Peninsula	388,400	$ 12,913,000	$ 1,553,536
Alt 3A – Rebuild Peninsula + Lakeside Reef	270,000	$ 14,371,000	$ 1,080,000
Alt 4A – Dredged Material Placement at Southern End + 1 Offshore Reef	156,000	$ 5,973,000	$ 618,700
Alt 4B – Dredged Material Placement at Southern End + 1 Offshore Reef	329,000	$ 11,416,000	$ 1,311,176
Alt 5A – Dredged Material Placement at Southern End + 2 Offshore Reefs	180,000	$ 11,516,00	$ 720,000

The L-QHEI scores were determined for the existing and predicted future conditions for each of the project alternatives and translated into Habitat Units (see Appendix D). Habitat units represent the quantity and quality of habitat provided by an alternative which were then converted into Average Annual Habitat Units (a metric of the amount or change in habitat units realized over the lifespan of the project). The without-project scenarios for each alternative assume that the existing conditions will be maintained into the future; therefore, the habitat units are unlikely to change over a 50-year period. The primary habitat type that would be restored or created in the project alternatives are Great Lakes marsh submerged wetlands (See Section 2.3.1).

The habitat assessment conducted on the existing and future biotic communities for the Woodtick Peninsula Section 204 project provided guidance in determining which alternatives were likely to offer the greatest number of ecological benefits. All the with-project alternatives returned greater ecological benefits than their respective existing habitat conditions.

Table 5. Summary Table - L-QHEI scores and Habitat Units (HU) with (w/) and without (w/o) Project and Average Annual Habitat Units (AAHU)

		L-QHEI Scores		Habitat Units (HU)		Average Annual Habitat Units (AAHU)		
Alternative	**Acres**	**L-QHEI w/o**	**L-QHEI w/**	**HU w/o**	**HU w/**	**AAHU w/o**	**AAHU w/**	**Change in AAHU**
2A – leeward channel	129	48.41	62	22.94	67.18	22.94	61.13	38.19
2B – leeward channel	142	48.41	62	22.94	75.24	22.94	68.46	45.53
3A – channel and lakeside site	129	50.88	56	31.19	60.68	31.19	55.21	24.03
4A – southern end	115	48.41	68	22.94	69.37	22.94	63.12	40.19
4B – southern end	116	48.41	68	22.94	70.05	22.94	63.74	40.81
5A – channel, southern end, lakeside site	115	50.88	59	31.19	60.19	31.19	54.77	23.59

Alternatives 2A, 2B, 4A, and 4B have the potential to provide the largest number of ecological benefits throughout the first 50 years after project implementation. Since all of the alternatives increased average annual habitat units (AAHU's), they were carried forward for cost effective and incremental cost analysis.

3.8.3 Cost Effectiveness/Incremental Cost Analysis (CE/ICA)

For ecosystem restoration planning, where traditional benefit-cost analysis is not possible because costs and benefits are expressed in different units, cost effectiveness analyses offer plan evaluation approaches that are consistent with the Principles and Guidelines.

The Cost Effectiveness portion of the analysis is conducted to ensure that the least cost plans are identified for each possible level of ecosystem restoration output; and that for any level of investment, the maximum level of output is identified. The purpose of the CE/ICA is to discover and display variation in cost and output. The IWR Planning Suite II, software application was used to complete this CE/ICA analyses. The outputs of CE/ICA are used as one factor in the selection of a Tentatively Selected Plan.

The CE/ICA evaluates the cost effectiveness of each of the alternative plans and identifies and eliminates economically irrational solutions. Plans are considered to be "cost effective" when no other plan provides the same environmental output level for less cost, or no other plan provides a

higher output level for the same or less cost. “Best buy” plans are a subset of cost- effective plans that have the greatest increase in output of the least increase in cost (lowest incremental costs per output). The CE/ICA requires comparison of costs and benefits in average annual terms. Table 6 illustrates the average annual costs and benefits used in the incremental CE/ICA.

Table 6. Average Annual Cost and Benefits used in the CE/ICA (FY22 price levels, 2.25% discount rate)

Plan	Alternative Description	Total Average Annual Benefits (Net AAHUs)	Total Average Annual Cost ($1,000)	Total Initial Investment Cost ($1,000)
2A	Rebuild Peninsula	38.76	222.21	8,613
2b	Rebuild Peninsula	46.09	286.24	13,193
3A	Rebuild Peninsula + Lakeside Reef	50.27	292.02	14,680
4A	Dredged Material Placement at Southern End + 1 Offshore Reef	40.38	151.44	6,115
4B	Dredged Material Placement at Southern End + 1 Offshore Reef	40.99	284.63	11,667
5A	Dredged Material Placement at Southern End + 2 Offshore Reefs	51.5	228.50	11,768

Six alternatives (in addition to the No Action/Without Project Condition) were evaluated in the CE/ICA. Of these, three plans (Alternative 2B, 4A, and 4B) were identified as being cost effective and two were identified as best buy plans (Alternative 2B and 4A). The “Best Buy” plans represent the most efficient means of achieving the given level of benefit among the identified cost-effective plans. Results of the cost-effectiveness analysis are presented in Table 7. The following figures (Figure 11 and Figure 12) illustrate the CE analysis results, showing average annual environmental benefits (horizontal axis) and average annual costs (vertical axis) of the alternatives, as well as the No Action Plan, which is carried forward for comparison purposes only.

Table 7. Results of Cost Effectiveness Analysis

Plan	Alternative Description	Average Annual Benefits (HUs)	Average Annual Cost ($1,000’s / AAHUs)
4A	Dredged Material Placement at Southern End + 1 Offshore Reef	40.38	151.44
4B	Dredged Material Placement at Southern End + 1 Offshore Reef	40.99	284.63
5A	Dredged Material Placement at Southern End + 2 Offshore Reefs	51.50	228.50

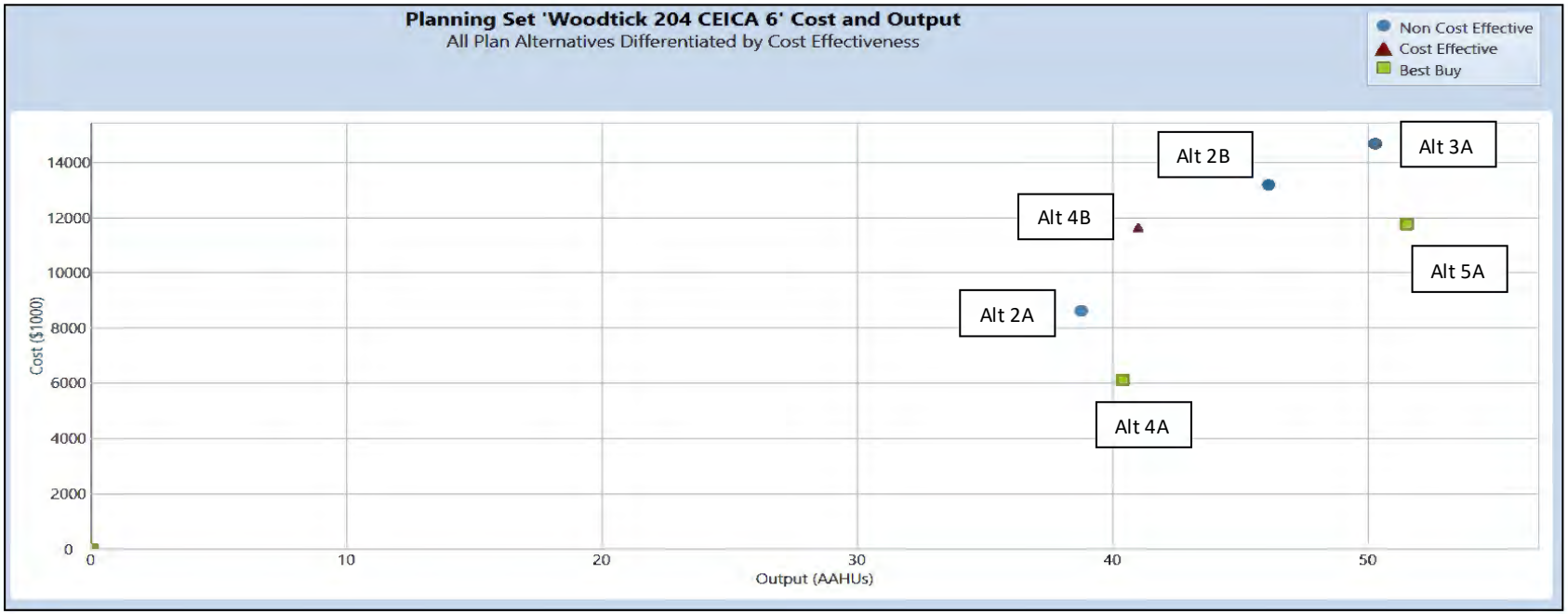

Figure 11. Cost Effective Plans

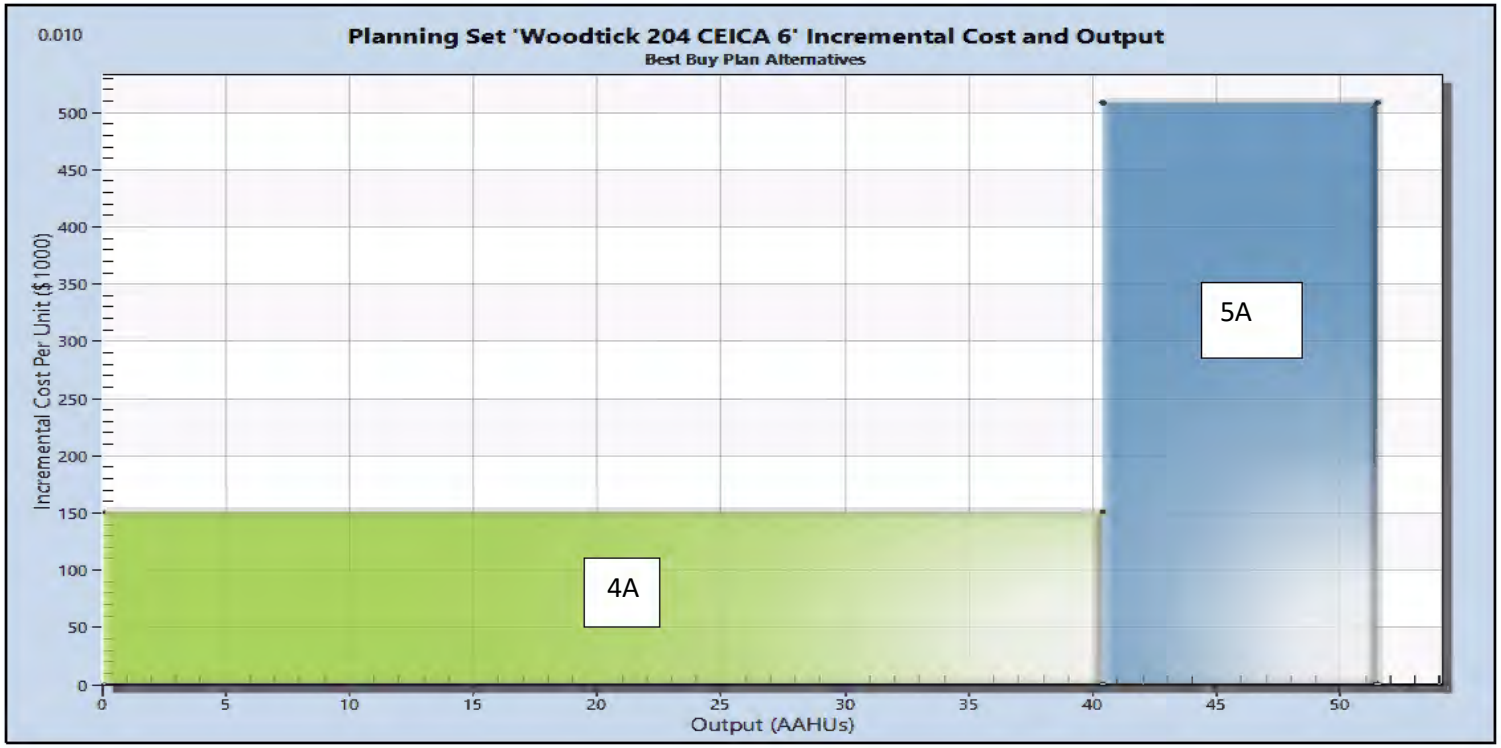

Figure 12. Cost Effectiveness/Incremental Cost Analysis Graph showing Best Buy plans.

Table 8. Results of Incremental Cost Analysis (Best Buy Plans)

Plan	Average Annual Costs ($1,000 / AAHU)	Average Annual Benefits (HUs)	Incremental Cost ($1,000)	Incremental Output (AAHU)	Incremental Cost/Output ($1,000 / AAHU)
No Action	0	0	0	0	0
4A	151.44	40.38	6.115	40.38	151.44
5A	228.50	51.50	5.653	11.12	508.36

Table 7 illustrates differences between the two identified "Best Buy" plans. Average Annual Costs (AAC) for an additional AAHU are greater between Alternative 4A and Alternative 5A. . Based on the CE/ICA analysis, Alternative 4A provides the greatest benefits for the investment amount. This is one factor in determining the Tentatively Selected Plan.

3.8.4 Screening of Alternative Plans – P&G Criteria

Completeness, effectiveness, efficiency, and acceptability are the four evaluation criteria specified in the Council for Environmental Quality Principles and Guidelines (P&G) (Paragraph 1.6.2(c)) in the evaluation and screening of alternative plans. Alternatives considered in any planning study should meet minimum subjective standards of these criteria to qualify for further consideration and comparison with other plans.

Completeness is the extent to which a given alternative plan provides and accounts for all necessary investments or other actions to ensure the realization of the planned effects.

Effectiveness is the extent to which an alternative plan alleviates the specified problems and achieves the specified opportunities.

Efficiency is the extent to which an alternative plan is a cost-effective means of alleviating the specified problems and realizing the specified opportunities, consistent with protecting the nation's environment.

Acceptability is the workability and viability of an alternative plan with respect to acceptance by State and local entities, tribes, and the public and compatibility with existing laws, regulations, and public policies.

Based on this evaluation summarized above, all action alternatives are considered complete because they provide and account for all necessary investments or other actions to ensure the realization of the planned effects. The No Action Alternative is not complete. In addition, all action alternatives analyzed are effective at improving Habitat Units and utilizing dredged material from Toledo Harbor. The No Action Alternative does not effectively alleviate problems or achieve the project objectives. Per the CE/ICA analysis in Section 3.8.3 Alternatives 2A, 2B

and 3 are not cost-effective means of alleviating the problems and realizing the specific opportunities. Alternatives 4A4B, and 5A are cost effective alternatives.

Table 9. Principles and Guidelines Screening Criteria

Alternative	Completeness	Effectiveness	Efficiency	Acceptability
No Action Alternative	No	No	No	No
Alt. 2A	Yes	Yes	No	Yes
Alt. 2B	Yes	Yes	Yes	Yes
Alt. 3	Yes	Yes	No	Yes
Alt. 4A	Yes	Yes	Yes	Yes
Alt. 4B	Yes	Yes	Yes	Yes
Alt. 5	Yes	Yes	No	Yes

All action alternatives provide a cost-effective means of a achieving the objectives. Finally, all alternatives are acceptable in terms of compatibility with existing laws, regulations, and public policies.

3.8.5 Screening of Alternatives – Significance of Ecosystem Outputs

Due to the challenge of dealing with non-monetized benefits, the concept of output significance plays an important role in ecosystem restoration evaluation. Along with information from the CE/ICA, information on the significance of ecosystem outputs will help determine whether the proposed environmental investment is worth its cost.

Statements of significance provide qualitative information to help decision makers evaluate whether the value of the resources of any given restoration alternative are worth the costs incurred to produce them. The significance of the Woodtick Peninsula restoration outputs are discussed in terms of institutional, public, and/or technical importance.

3.8.5.1 Institutional Recognition

Significance based on institutional recognition means that the importance of an environmental resource is acknowledged in the laws, adopted plans, and other policy statements of public agencies, Tribes, or private groups. Western Lake Erie, where Woodtick Peninsula is located, has been recognized as an area of importance through several publications most notably:

- The Western Lake Erie Region is one of 34 unique habitat areas identified in The North American Waterfowl Management Plan published by USFWS.
- The Western Lake Erie region is featured in "Returning to a Healthy Lake: Lake Erie Biodiversity Conservation Strategy (The Nature Conservancy, Michigan Natural Features Inventory).
- Western Lake Erie is part of the Regional Shorebird Reserve (Western Hemispheric Shorebird Reserve Network)

3.8.5.2 Public Recognition

Public recognition means that some segment of the general public recognizes the importance of an environmental resource, as evidenced by people engaged in activities that reflect an interest or concern for that particular resource. Such activities may involve membership in an organization, financial contributions to resource-related efforts, and providing volunteer labor and correspondence regarding the importance of the resource. Woodtick Peninsula is considered part of the Erie State Game Area and offers extensive opportunities for the public for hunting, fishing, bird-watching, and other resource related activities. There are numerous stakeholder groups active in the Western Lake Erie Region including, but not limited to Ducks Unlimited, Lake Erie Marsh Committee, and The Nature Conservancy. Based on coordination with the local sponsor and other resource agencies, it is apparent that there is significant community interest in a project at Woodtick Peninsula.

3.8.5.3 Technical Recognition (Scarcity, Representativeness, Status and Trends, Connectivity, Limiting Habitat, Biodiversity)

Technical recognition means that the resource qualifies as significant based on its "technical" merits, which are based on scientific knowledge or judgment of critical resource characteristics. Technical significance should be described in terms of one or more of the following criteria or concepts: scarcity, representation, status and trends, connectivity, limiting habitat and biodiversity. An ecosystem restoration project at Woodtick Peninsula would contribute the following to the technical recognition measures:

Scarcity – This is a measure of a resource's relative abundance within a specified geographic range. Only 5% of the original 307,000 acres of Lake Erie wetland currently remain and approximately 10% of those wetlands are located within Woodtick Peninsula or directly adjacent. Various wetland habitat types are a scarce resource in western Lake Erie. Implementation of any action alternative to increase high-quality aquatic habitat would be beneficial to the area in terms of creating scarce habitat.

Representativeness – This is a measure of a resource's ability to exemplify the natural habitat or ecosystems within a specified range. Woodtick Peninsula also holds considerable historical significance in the area. Currently, the project area does not represent a natural habitat as high quality aquatic and wetland habitat is minimal throughout the area. Invasive species are prevalent throughout the project area. As a result of these conditions, Woodtick Peninsula does not represent a natural undisturbed habitat. Implementation of any of actionable alternatives would help to restore aquatic habitat to a state more representative of the habitat historically found along the western Lake Erie shoreline.

Status and Trends – This concept involves evaluating the occurrence and extent of the resource over time, how it has changed, and why. High-quality aquatic habitat has been in decline in western Lake Erie since the start of the 1900s. While all of the alternatives under consideration would likely benefit by increasing high-quality habitat, Alternatives 3, 4A, 4B, and 5 would

likely have the greatest benefit since they all include an offshore reef. This offshore reef will help in creating a greater variety of habitat and would thereby benefit a wider range of species.

Connectivity – This is a measure of the potential for movement and dispersal of species throughout a given are or ecosystem and should be considered in the context of an entire landscape or watershed. Implementation of the tentatively selected plan would increase the wetland habitat connectivity of the area by providing suitable foraging habitat for the avian community, spawning and nursery habitat for the local fish community, and improve the quality of water to the surrounding areas waters. Each of the alternatives considered would help to improve connectivity within the western Lake Erie basin. Further, each of the alternatives proposed would contribute to the cumulative benefits provided by other restoration activities completed or scheduled in surrounding vicinity.

Limiting habitat – This is habitat that is essential for the conservation, survival, or recovery of one or more species. Limited habitat exists throughout the Woodtick Peninsula study area. State threatened species found in Monroe County that may benefit from the proposed project include the bald eagle. In addition, there is very limited high-quality fish habitat throughout western Lake Erie. A variety of fish species would likely benefit from the proposed project including walleye, smallmouth bass, and largemouth bass.

Biodiversity – This is a measure of the variety of distinct species and the genetic variability within them. . There is concern about phragmites colonization in the area and the overall general loss of coastal wetlands. For a biodiversity standpoint, Woodtick Peninsula is a critical area for migratory birds and spawning, nursery, and feeding habitat for a wide variety of fish species. The project would support existing diversity of Lake Erie (and Great Lakes) coastal wetlands through the expansion of existing submerged aquatic vegetation wetland habitat. This would support a greater abundance of existing species, potentially reducing stressors on those species brought on by the loss of wetlands across the Great Lakes.

3.8.6 Screening of Alternatives – The Four Accounts

The evaluation and comparison process incorporated Four Accounts to facilitate evaluation and display of effects of alternative plans. The four accounts are national economic development (NED), environmental quality (EQ), regional economic development (RED) and other social effects (OSE). The Federal Objective is to determine which of the project alternatives provide maximum net benefits while protecting or minimizing negative impacts to the environment. Recent USACE guidance (5 January 2021 SACW Memo, "SUBJECT: POLICY DIRECTIVE – Comprehensive Documents of Benefits in Decision Document" (referred to as the Benefits Memo)) directed feasibility studies to "ensure the USACE decision framework considers, in a comprehensive manner, the total benefits of project alternatives, including equal consideration of economic, environmental and social categories." The following section provides an assessment of the alternatives across the four accounts in accordance with the referenced benefits memo. Results can be presented qualitatively or quantitatively (Table 10).

Table 10. Alternative Plans Summary Comparison

Alternative Plans Summary Comparison							
1. Plan Description	1. No Action Alternative/ Future Without Project Condition	2A. Rebuild Peninsula	2B. Rebuild Peninsula	3A. Rebuild Peninsula + Lakeside Reef	4A. Dredged material placement at southern end + 1 offshore reef **(NER - Best Buy)**	4B. Dredged material placement at southern end + 1 offshore reef	Alt 5. Dredged Material Placement at Southern End + 2 offshore reefs
2. IMPACT ASSESSMENT							
A. National Economic Development							
(1) Project costs (FY22 first cost) (2) Dredged material capacity preserved at Toledo Harbor placement sites. (3) Volume of dredged material placed somewhere other than the open lake disposal site (cy)	(1) 0 (2) No, Toledo Harbor dredged material will be placed in the CDF. (3) zero	(1) $7,796,000 (2) Yes, Toledo Harbor dredged material will avoid placement in the CDF. (3) 245,500	(1) $11,952,000 (2) Yes, Toledo Harbor dredged material will avoid placement in the CDF. (3) 388,400	(1) $13,301,000 (2) Yes, Toledo Harbor dredged material will avoid placement in the CDF. (3) 270,000)	(1) $5,529,000 (2) Yes, Toledo Harbor dredged material will avoid placement in the CDF. (3) 156,000	(1) $10,567,000 (2) Yes, Toledo Harbor dredged material will avoid placement in the CDF. (3) 329,000	(1) $10,659,000 (2) Yes, Toledo Harbor dredged material will avoid placement in the CDF. (3) 180,000
B. Regional Economic Development (RED)							
	No change.	Greater regional economic impact compared to Alt 4A.	Greater regional economic impact compared to Alt 4A.	Greater regional economic impact compared to Alt 4A.	Beneficial use of dredged material would likely result in short-term increases in local spending, tax revenue, economic	Greater regional economic impact compared to Alt 4A.	Greater regional economic impact compared to Alt 4A.

					output, and full-time employment positions.		
C. Other Social Effects (OSE)							
1.) Increase coastal resiliency	No	Yes	Yes	Yes	Yes	Yes	Yes
2.) Restore Historic Footprint	No	Yes	Yes	Yes	Yes	Yes	Yes
D. Environmental Quality							
(1) CE/ICA (Average Annual Habitat Units)	(1) Non-cost effective (2) -	Non-cost effective (2) 38.19	Non cost-effective (2) 45.53	Non-cost effective (2) 24.03	Best Buy (2) 40.19	Cost Effective (2) 40.81	Best Buy (2) 23.59
(1) Soils	No effect	Minimal impacts due to change from sub-emergent to emergent habitat	Minimal impacts due to change from sub-emergent to emergent habitat	Possible increase in sedimentation near offshore reefs and impacts associated with upland area.	Minimal impacts due to change from sub-emergent to emergent habitat	Minimal impacts due to change from sub-emergent to emergent habitat	Possible increase in sedimentation near offshore reefs and impacts associated with upland area.
(2) Aquatic Resources	No effect	No increased impairment to Lake Erie Surface water, no effects to floodplains, and beneficial effects by improving and enhancing area wetlands					
(3) Fish and Wildlife Habitat	No effect	Minor and short-term impacts expected during the construction phase.					
(4) T&E species	No effect	May affect, but not likely to adversely affect the Indiana bat, Northern long eared bat, and the Eastern prairie fringed orchid. No effect on Piping plover, Red knot, Eastern Massasauga, Northern Riffleshell, Rayed Bean, and the Karner Blue Butterfly					
(5) Recreational	No effect						
(6). Cultural Resources	No risk to archeological sites	Potential to have an adverse effect on archeological sites					
(7). Air Quality	No effect	Short term, minor impacts expected during construction					
(8). Noise	No effect	Short term, minor impacts expected during construction					
(9). HTRW	No effect	No increased risk of disturbance.					

(10). Socioeconomic and Environmental Justice	No effect	All action alternatives would not result in disproportionately high or adverse human health or environmental effects on minority or low-income populations.
(11). Climate change	No effect	No change in water levels, GHG emissions or regional temperatures or precipitation from existing conditions

3.8.6.1 National Economic Development (NED)

The NED account displays changes in the economic value of the national output of goods and services. Economic benefits include the benefit to the Nation through beneficially using dredged material and avoiding the use of USACE approved dredged material placement sites. Beneficially using dredged material allows USACE to maintain capacity in approved dredged material placement sites and therefore allows for a longer life of the site. Considering avoiding placement in a USACE approved placement site as a benefit, Alternative 2B would have the greatest benefit since it uses the most dredged material (388,400 cubic yards) out of any alternatives. Alternative 4A is the action alternative that uses the least amount of dredged material and therefore would have the least NED benefits. Based on this assessment Alternative 2B would be considered the NED plan.

3.8.6.2 Regional Economic Development

The RED account measures changes in the distribution of regional economic activity that would result from each alternative plan. The RED impact analysis for Alternative 4A was evaluated at the local, state, and national levels. The regional economic effects are shown for the local, state, and national impact areas. In summary, the expenditures $6,563,973 support a total of 83.6 full-time equivalent jobs, $4,872,691 in labor income, $4,570,833 in the gross regional product, and $8,355,646 in economic output in the local impact area. More broadly, these expenditures support 164.8 full-time equivalent jobs, $9,819,576 in labor income, $11,751,510 in the gross regional product, and $20,949,877 in economic output to the nation.

It is expected that alternatives with a higher construction cost would have a greater impact on RED in terms of full-time equivalent jobs, labor income, gross regional product, and total economic output in the local impact area. Assuming Civil Works expenditures (Project first costs) directly creates positive RED benefits, Alternative 3 would have the greatest positive impact to RED. This is because Alternative 3 requires approximately $13 million dollars (FY22) to implement and is the alternative with the largest construction cost. The No Action Alternative would have the least impact on RED, since no funding would be expended and no improvements to the peninsula would be made. Among the action alternatives, Alternative 4A would have the least impact to the RED of the area since no dredging would be required to implement it. In comparison to Alternative 4A (Best Buy Plan), alternatives 3, 2B, 5, 4B, and 2A would provide greater regional benefits due to the increased project cost and associated impacts to the regional economy.

3.8.6.3 Environmental Quality

The Environmental Quality account considers non-monetary effects on ecological, cultural, and aesthetic resources. Under this account, the environmental effects of the implementation of the alternatives are not anticipated to have significant environmental impacts. Environmental effects of beneficial use of dredged material versus no action are discussed in Chapter 4. An CE/ICA analysis was performed for this account as required for Civil Works projects with an ecosystem restoration purpose. The results of this analysis are in Section 3.8.3. In summary, the CE/ICA

analysis identified two "best buy" Plans. These are Alternative 5A and 4A. "Best Buy Plans" are cost effective plans that are "worth" the incremental investment. Average annual costs for an additional AAHU are nearly double between Alternative 4A and Alternative 2B. Based on the CE/ICA analysis, Alternative 4A provides the greatest benefits for the investment amount.

3.8.6.4 Other Social Effects

The Other Social Effects (OSE) account is a means of displaying and integrating into water resources planning information not reflected in the other three accounts. In this category, improving coastal resiliency and restoring the historic footprint of Woodtick Peninsula were qualitatively considered. Stakeholders and the NFS expressed keen interest in efforts that could allow for Woodtick Peninsula to "bounce back" and be resilient to future storms, high lake levels, and continued erosion. While the focus of the study was improving and enhancing habitat which would directly improve coastal resiliency, another focus was on restoring the historic footprint. Woodtick Peninsula has experience significant erosion at the southern end and there is community concern that Lake Erie will eventually breach the peninsula and effectively cut off the southern end. . Woodtick Peninsula is viewed as a key asset that provides protection to the Erie Marsh Preserve, one of the largest marshes in Lake Erie. There is significant concern, that if Woodtick Peninsula were to completely erode away, that the Erie Marsh Preserve would be significantly threatened by erosion and destruction as well.

The No Action alternative would not improve coastal resiliency or restore the historic footprint of Woodtick Peninsula. Among the action alternatives, all alternatives would improve coastal resiliency and assist in restoring the historic footprint to various degrees. Alternative 2A and 2B would enhance coastal resiliency by creating additional wetlands on the lee side of Woodtick Peninsula and thereby helping to stabilize the peninsula from flanking erosion effects. Alternative 2A and 2B would minimally restore the historic footprint of the peninsula. This is in comparison to Alternative 3 and 5 which includes in-water placement on the leeside of the peninsula plus a 40 acre upland placement site on the lakeside of the peninsula. Both of these alternatives include an offshore reef on the lakeside of the peninsula near the upland placement area. The offshore reef, while utilizing dredged material and providing fish habitat would have the added benefit of protecting a part of Woodtick Peninsula from Lake Erie wave action. The lakeside reef could encourage sediment buildup between the shoreline and the reef and essentially act as an area that captures littoral transport. This could provide further stabilization and protection benefits to the southern part of Woodtick Peninsula. The upland placement site directly addresses a key area of Woodtick that has experienced erosion and dredged material placement here would meet the intent to restore the Peninsula's historic footprint. Due to the shallow nature of the area, the offshore lakeside reef will be partially above water which could cause negative impacts for recreational boaters in the area.

Alternative 4A and 4B enhances coastal resiliency to a greater degree and restores the historic footprint of the peninsula greater than Alternative 2A and 2B, but likely to a lesser extent than Alternative 3 and 5. Alternative 4A and 4B both include an offshore reef, constructed of GSCs

with appropriately-sized stone placed on top, along the southern tip of Woodtick Peninsula. This reef is designed to be predominately underwater, though it could be exposed in periods of low water, which may negatively impact recreational boating. However, it's constructed location means that it will likely catch littoral drift sediments and could potentially increase the size of the shoreline at the southern end of the peninsula and stabilize the area . This would contribute to OSE benefits protecting these public lands for future recreational use. The offshore reef in Alternative 4A and 4B is likely to help stabilize and therefore protect the southern end of Woodtick Peninsula, which has been identified as an important area by the NFS and stakeholders.

Furthermore, Woodtick Peninsula was added to the National Register of Historic Places (NRHP) as part of the North Maumee Bay Archeological District in 1980 due to the presence of Late Woodland Period (700 – 1000 A.D.) sites. (See Section 2.4). The NRHP form notes that the sites present on Woodtick Peninsula and the surrounding islands have suffered from erosion due to raising water levels of the North Maumee Bay and Lake Erie, which has continued to the present-day (Pratt, 1980). In comparing recorded site locations on Woodtick Peninsula to the landform's current condition, it seems likely that continued shoreline erosion may have resulted in the destruction of the sites identified in the 1970's excavations. If these sites were not fully destroyed by erosion, there is potential that these sites might be either be extant underwater or material from these sites that would have eroded may have been redeposited along the shoreline as a result of the dynamic wave action. Considering the cultural history of the area, the density and significance of sites previously found in the archeological district, and lack of recent investigations on the peninsula there is significant evidence that there are still sites present or surviving materials from previously identified sites on or in the waters adjacent to Woodtick Peninsula that could be adversely affected by the proposed project. There is a benefit to a project that would reduce or minimize erosion from a cultural resources perspective as these sites would not be disturbed.

3.8.7 Plan Selection

The following designations are made in the selection process:

3.8.7.1 The NER Plan

The plan that reasonably maximizes net national ecosystem restoration benefits and is consistent with the Federal objective is identified as the NER plan. As mentioned in Section 3.8.3, cost effectiveness/incremental cost analysis identified Alternative 5A and Alternative 4A as best buy plans while Alternative 4B was identified as being cost effective. Since several alternatives provided significant ecosystem restoration benefits in a cost-effective manner, the no-action plan was removed from consideration as the NER plan. As indicated in Figure 11, the incremental cost of implementing Alternative 4A appears to provide the "greatest bang for the buck" in terms of units of habitat per dollar spent. Thus, the alternative that maximizes net NER benefits, is the most cost effective, and provides a "Best buy" is Alternative 4A. In keeping with the NER

objective of water resources planning, the plan that reasonably maximizes ecosystem benefits compared to costs is selected as the NER Plan.

3.8.7.2 Designation of the Tentatively Selected Plan

Alternative 4A is designated as the Tentatively Selected Plan (TSP) due to the fact that it is designated as a cost-effective plan, is within the Section 204 authority per-project cost limits and is supported by the non-federal sponsor. Alternative 2B (NED Plan) was considered, however, due to the high cost and lack of offshore reef features, the PDT, in conjunction with the non-federal sponsor has designated alternative 4A as the TSP. The offshore reefs provide additional benefits, discussed in the OSE account, related to enhancing coastal resiliency and restoring the historic footprint of the peninsula while utilizing a significant volume of dredged material. Alternative 4A meets the objectives of the project to beneficially use dredged material and improve habitat within Woodtick Peninsula.

Table 11. TSP Average Annual Costs and Benefits

TENTATIVELY SELECTED PLAN AVERAGE ANNUAL COSTS AND BENEFITS Federal Discount Rate FY22 = 2.250%, FY 2022 Price Levels, 50-Year Period of Analysis	
Element	Total ($)
Project First Costs	
Construction	4,060,000
LERRDS	57,500
Monitoring	21,000
O&M	10,000
Adaptive Management	91,000
Preconstruction, Engineering, and Design	952,000
Construction Management	503,000
Total Project First Costs	5,694,500
Average Annual Costs	
Construction	220,013
Interest During Construction	67,458
Annual OMRR&R	10,000
Total Average Annual Cost	297,471
Average Annual Benefits (HUs)	40.19

*This table includes the Real Estate cost estimate used for benefit calculations which is $57,500. For the parametric cost estimate (Section 3.7, Table 3) a Real Estate cost of $14,000 was used which is a standard placeholder value. The parametric cost estimate did not include costs for Monitoring, O&M, and Adaptive management. These costs were used in the economic evaluation of alternatives.

4 ENVIRONMENTAL CONSEQUENCES OF ALTERNATIVES

This chapter provides the Existing Conditions and regulatory setting for each of the resources that could be affected by implementing any of the alternatives as identified in Section 3.7. Existing conditions are the physical, chemical, biological, and sociological characteristics of the project area as discussed in Chapter 2. The assessment of environmental effects is based on a comparison of conditions with and without implementation of the proposed plan and reasonable range of alternatives. The spatial scale of this analysis focuses on the Woodtick Peninsula and its adjacent waters.

Environmental consequences of the alternatives will result from two primary actions: placement of dredged material from Toledo Harbor, OH and the creation of in-water artificial reefs using geosynthetic containers.

All action alternatives involve the placement of dredged material from Toledo Harbor, OH in the nearshore waters surrounding Woodtick Peninsula to an elevation of 570.75 feet, extending toward open water at a 1:20 slope, to a bottom elevation of 562 feet (see Section 3.7). While the placement locations and total area of placement differ across alternatives, it is reasonable to expect that the environmental consequences would be similar. In addition, alternatives 3 and 5 will also have to include the placement of dredged material on the lakeside of the peninsula to an elevation of approximately 574 feet within a 40-acre footprint. While this expands the dredge footprint to include the lakeside of the peninsula, the action only differs from the other dredged material placement in that it will be placed to a higher elevation. The environmental consequences of this difference in elevation will be noted where applicable. Dredged material will be sourced from the Toledo Harbor Federal Navigation Project which is located to the south and east of Woodtick Peninsula. This material is comprised of between 35% and 98% silts and clays, with the remainder being mostly sands.

Alternatives 3, 4, and 5 would also include creation an in-water artificial reef via geosynthetic containers (GSCs) filled with dredged material. These containers would be placed to an elevation of approximately 566.2 – 566.5 feet and covered by stone. The placement locations and total area of created reef will differ between alternatives, however the environmental consequences of each are expected to be similar.

The alternatives, and methods necessary to accomplish their construction, will include both direct and indirect environmental consequences. Direct impacts are impacts that are the result of project actions and occur at the same time and location as the action(s). Indirect impacts are reasonably foreseeable impacts that are the result of project actions but occur later in time and/or are removed from the project area or location of the action.

4.1 SOILS

These materials were evaluated pursuant to Section 404(b)(1) of the Clean Water Act (33 USC 1344) and 40 CFR 230, "Guidelines for the Specification of Disposal Sites for Dredged and Fill Material." According to both evaluations and applicable guidelines, discharge of Toledo Harbor dredged material in the open waters of Lake Erie would not result unacceptable adverse effects to the aquatic ecosystem (Appendix I).

Toledo Harbor dredged material is similar in composition to the existing material at Woodtick Peninsula with the exception of the lakeward side. The lakeward placement area in Alternatives 3 and 5 would be covering mostly sand (~80%) with dredged material that has a higher percentage of fines. While the placement in the lakeward area does represent a change in the grain-size characteristics of the site, placement would increase the overall elevation from a submergent wetland to an emergent wetland. This change in elevation would be expected to have a similar or greater positive impact on the environment than as the difference in grain size alone.

The construction of artificial reef structures in Alternatives 3 and 5 may also lead to increased sedimentation surrounding the reef structures. This may cause localized areas around the reefs to have a higher percentage of fine material than open-lake facing beach and bottomlands. This effect would be limited to areas behind the reefs, sheltering those areas from open-lake wave action and also be dependent on the sediment load entering the system to be affected by changes in the wave climate resulting from the artificial reefs.

4.2 AQUATIC RESOURCES

4.2.1 Surface Water

All sediment dredged from the Toledo Harbor Federal Navigation Project is suitable for open-lake placement, in accordance with the most recent Clean Water Act Section 404(b)(1) Evaluation completed in September 2020.

Placement of the dredged material may result in increases in nutrient loads to the project area resulting from high nutrient inputs to the Maumee River from surrounding agricultural activities (IJC, 2013; Ouyang, 2005). However, sediments in the western basin of Lake Erie can be a net sink for nutrients or convert nutrients into energetically favorable states for primary production (Boedecker et al., 2020). The transfer of material from the navigation channel to Woodtick Peninsula would not impact nutrient cycling that naturally occurs within these sediments, nor would it be removing or introducing nutrients from the western Lake Erie basin overall.

As a result, the project Alternatives will not significantly contribute to the status of Lake Erie surface waters as impaired (Richards et al., 2010; Smith et al., 2015). It will also not address the main drivers of that impairment (IJC, 2013; Daloglu et al., 2012; Ouyang, 2005; Richards et al., 2010; Smith et al., 2015a; Stow et al., 2015; Watson et al., 2016).

4.2.2 Groundwater

The Alternatives are intended to increase the existing bottom elevations at the site; however the amount of fill and areas of placement will not likely have any impact on the groundwater table elevation, stage, or head gradient. Given that the water table elevation in this area is essentially flat in this area, it is expected that groundwater will continue to exhibit alternating flow towards and away from the Lake depending on Lake levels relative to groundwater stage (Haack et al., 2005). Material from the Toledo Harbor Federal Navigation Project should not have an appreciable impact on the quality or content of groundwater discharge to Lake Erie in this area.

4.2.3 Flood Plains

No Alternatives will alter any flood plains or lead to appreciable impacts on the chances that Woodtick Peninsula will flood during modeled flood events. The Alternatives are intended to restore the wetland and reduce storm damage, including erosion from typical storm and flood events.

4.2.4 Wetlands

All alternatives are to meet an objective to expand, restore, and enhance the existing coastal, emergent, and submergent wetlands within the study area to improve fish and wildlife habitat. The target for in in-water areas is to increase the L-QHEI scores (Table 2), primarily by increasing the aquatic vegetation quality score to a target of 16, and the cover type score to a target of 18. The increase in aquatic vegetation quality score is based on the assumption that pond lilies, pond weed, and waterweed will be common throughout the project area and wild celery will be present in small numbers and distribution. The increase in the cover type is through the expansion of cover, and an increase in the types of available cover, to include SAV, woody debris, and overhanging vegetation. Increased quality (diversity, richness, and area) of the SAV and cover will benefit wetland wildlife and the water quality of both Woodtick Peninsula and Lake Erie.

As such, the wetlands within and adjacent to project area will benefit from the action alternatives. This will enhance and expand the size of functioning submergent wetlands (and emergent for Alternatives 3 and 5) which are a component of one of the largest remaining wetland complexes in Lake Erie. This will support goals of the North American Waterfowl Management Plan (USFWS, 1986) and the Lake Erie Lakewide Action & Management Plan (ECCC/EPA, 2021).

4.3 FISH AND WILDLIFE HABITATS

4.3.1 Terrestrial and Aquatic Vegetation

4.3.1.1 Terrestrial Vegetation

The construction of all action alternatives and their associated activities would take place in-water and not access the site via overland routes. There are also no plans to conduct *Phragmites* or other invasive or weedy species control on the emergent (upland) portions of the Peninsula

within the project area. Therefore, the only direct impacts to terrestrial vegetation will occur as part of Alternatives 3 and 5 where placement of material on the lakeward side of the Peninsula (Figures 7 and 10) will create 40 acres of new substrate for terrestrial vegetation. Construction will be required to use Best Management Practices (BMPs) to prevent or otherwise minimize direct and indirect impacts to emergent areas and vegetation. BMPs will include, but not be limited to: no cutting of trees, no tying off of equipment or supports on trees, dust controls, erosion controls, and restrictions on work areas.

Following the completion of placement and construction activities, this area will be planted with seeds, plant plugs, and saplings of native species typical of a Great Lakes Marsh. Species, and the type of planting, will be selected based on their potential for natural recolonization and literature on establishment success for various types of plantings. Direct impacts in this placement area will continue for 2-5 years in the form of establishment maintenance to prevent the expansion of *Phragmites* into this area while also promoting the growth of the native plantings.

Indirect impacts to terrestrial vegetation will include the protection of Woodtick Peninsula emergent habitat (all action alternatives) to maintain existing area and structure, and the creation of new emergent habitat (Alternatives 3 and 5). The protection of Woodtick Peninsula will allow for natural ecosystem function to continue, including community succession. Increased submergent wetland habitat and SAV may increase the number of wetland species inhabiting Woodtick Peninsula, including as stopover habitat during migrations. It is not anticipated that the number of species and individuals would increase to a level that this ecosystem could not sustain or would cause negative impacts on the terrestrial vegetation through ecosystem engineering.

4.3.1.2 Aquatic Vegetation

Release of dredged material during placement operations will have direct effects on SAV ecology and physiology by reducing light penetration into the water column, burial or smothering of plant matter (including seeds), changes in water depth, and changes to the soil type. Indirect effects include the release of nutrients associated with dredge material.

It is expected that existing biomass would be buried beneath placed dredged material of various depth depending on proximity to the shore and final design (*i.e.* areas with higher elevations currently would likely need less material to be placed to achieve the final elevation). Studies have found that thin-layer placement (9 inches) has minimal to negligible impacts on the growth and primary production of wetland habitats (Reimold et al., 1978; Ray, 2007). Thicker layer placement will smother plant mass, reducing seed germination, seedling survival, growth of adults, and organic litter decomposition (Wang et al., 1994). All growth and survival metrics were greater with increased plant size or decreased sediment load/thickness. It is therefore expected that SAV, and associated primary production and photosynthesis, will be negatively impacted in areas where more than 9 inches of dredge material will be placed until such time as the area is re-colonized or restored with SAV.

Placement of dredge material in shallow environments (< 3.3 feet) will directly increase turbidity at the placement area, but any such increases will dissipate within approximately 65.6 feet of the placement area and on the order of hours (Fall et al., 2021). During dredged material discharge, transmissivity in the water column (percent of light transmitted, as a measurement of turbidity) will decreased to levels observed during typical Lake Erie storm events and return to virtually ambient values within an hour of the discharge of a dredged sediment slurry (Sweeney, 1978). In Maumee Bay and WLEB, water column TSS concentrations during runoff and storm events can range between about 50 to over 300 mg/L over a period of days (Herdendorf et al. 1977; Paul et al. 1982; Lick and Kang 1987; E&E/LimnoTech 2014). In effect, the elevated TSS concentrations from such storm events occur over the entire Maumee Bay and WLEB and persist for far longer (i.e., days) than the short-term (i.e., matter of minutes to an hour), intermittent, spatially isolated TSS events associated with the discharge of dredged sediment.

All SAV species observed in the project area have been classified as tolerant or very tolerant to disturbances (with the exception of wild celery, which was neither tolerant nor intolerant) and occupying a broad ecological niche (Croft and Chow-Fraser, 2007). In general, these species can grow relatively quickly, assimilate nutrients from both the water column and benthos, and outcompete other species for available light. As such, recolonization of submergent wetlands where dredged material is placed would be expected to occur in the short-term (3-5 years) as a result of dredge material raising the bottom elevations into the photic zone (Zhu et al., 2007; Depew et al., 2011). The growth and expansion of SAV in the project area will serve to stabilize the placed material, providing an indirect benefit to the long-term resilience of Woodtick Peninsula.

It is anticipated that pond lilies, pond weed, and waterweed would individually cover < 70% but ≥ 10% of the resulting bottom area and wild celery would cover < 10 %. This combination yields a L-QHEI score of 16 for aquatic vegetation quality.

4.3.2 Fauna

4.3.2.1 Fishes

The nearshore wetlands of Woodtick Peninsula likely serve as a primary nursery for recreationally and commercially important species, such as walleye and yellow perch (Roseman et al., 2005; Sullivan and Stepien, 2014). The direct impacts from the project alternatives include short-term physiological and behavioral changes in fish present within the project area, in addition to affecting any incubating eggs subject to increased sediment loads (Kjelland et al., 2015).

Adults that are within the project area, and experience direct impacts from project actions, will respond based on their individual perceived options available within their immediate water body at the time of exposure (Kjelland et al., 2015). While they will be capable of moving out of the area of effect, they may not choose to do so, thereby subjecting themselves to additional

physiological stressors from the increased sediment load. Depending on the species, these stressors may be sublethal, lethal, or both depending on the concentration and duration of exposure. The increase in suspended sediments will also alter the predator-prey dynamic, leading to changes in feeding behavior, feeding success, and predator avoidance (Kjelland et al., 2015). The response and tolerance to these changes is species-specific, with scientific literature indicating that opportunistic species experience less disruption than specialized trophic groups when exposed to dredging-related increases in turbidity. Combined, this indicates that the environmental consequences of implementing the action alternatives will be changes in the behavior of adult fishes within the effected area during active placement, followed by adaptation to the new environment over the lifespan of the project. These behavioral changes will not necessarily result in any positive or negative impacts to populations on the whole.

Project impacts to eggs and larvae may be more pronounced than to adults. Walleye eggs, fingerlings, and newly hatched larvae demonstrate resistance to sediment loads typically found during dredging operations, however these results were for short-duration exposures (2-3 days) which will likely be exceeded during active construction of this project (Suedel et al., 2012; Suedel et al., 2014). As a result, if placement operations were to occur during normal periods of fish spawning and egg incubation, it would be expected to lead to a decrease in egg hatching and survival of larval fish within the project area. Outside of the project area, no significant impacts to eggs and larvae are likely to occur.

An indirect impact of the action alternatives will be the loss of fish spawning and nursery habitat during, and in the years following, dredged material placement. This impact is correlated with the loss and re-establishment of SAV (see Section 4.3.1.2). Certain species show evidence of genetic isolation within the Great Lakes and the Huron-Erie corridor; a significant impact to more than one year class could impact the populations localized around Woodtick Peninsula however direct multi-year impacts are not expected (Sullivan and Stepien, 2014). As the SAV communities re-establish and the target ecosystem state is achieved over the lifespan of the project, the increase in submergent wetland habitat will have a beneficial impact on fishes in western Lake Erie through the expansion of important coastal wetland habitat (Roseman et al., 2005). The restoration and expansion of SAV will also serve to address existing beneficial use impairments (BUIs) in the Maumee River and Maumee Bay Area of Concern (Miller et al., 2018).

The placement of an artificial reef as part of Alternatives 3 and 5 will have the additional direct impact of creating additional 3-dimensional hard substrate habitat. Habitat of this type is found adjacent to Woodtick Peninsula (along the Consumer's Energy property to the north and numerous private properties throughout north Maumee Bay). Artificial reefs of similar design have been found to be successful at attracting recreational species and spawning fish, however a variety of factors complicate the overall success, or lack thereof, of such features (McLean et al., 2015). The highest levels of success observed for artificial reefs (determined based on limiting non-native species and promoting desirable species) were when the reefs were constructed using

quarried limestone between 4-8 inches in diameter (Manny et al., 2015). This type of material reduces the chance that non-native sea lamprey (*Petromyzon marinus*) and round goby (*Neogobius melanostomus*) will colonize the reef and either use it as spawning ground or prey on eggs of native fish species (Manny et al., 2015).

The combination of direct and indirect impacts from the action alternatives will result in short term (<5 years) negative impacts to fish species in the project area, followed by a long-term benefit as the target state is achieved. This benefit may be realized by both native and non-native species, however neither group will gain a greater benefit than the other, leaving the existing competition for resources in effect.

4.3.2.2 Invertebrates

The placement of Toledo Harbor material in the project area will lead to material being placed directly on top of individuals within the placement area in addition to increasing turbidity within the water column during and for a period of time following placement. The direct impacts of the increased sediment load and associated turbidity include mortality, reduced physiological function, and avoidance (Henley et al., 2000).

Insects and crustaceans are more likely to experience reduced physiological function and avoidance, whereas mollusks are more likely to experience reduced physiological and mortality due to their limited mobility.

Freshwater mussels have been found to be sensitive to smothering with a little as 0.25-1 inch of overburden (Goldsmith et al., 2021). The primary impacts of the Project Actions will reduce the clearance rates (a measure of feeding), increase respiratory stress, decrease fertilization success, decrease larvae development, and increase reproductive failure (including preventing attachment to fish hosts; Goldsmith et al., 2021). However, these impacts were less pronounced in non-native dreissenid mussels which exhibited more resistance and acclimation potential to increased turbidity (Summers et al., 1996; Thorp et al., 1998). Therefore, the primary consequences to freshwater mussels will be the negative impacts to native mussel species within and adjacent to the project site (*i.e.* with the turbidity plume resulting from material placement) and no impact or a lesser negative impact to non-native dreissenid mussels.

The indirect effects of the project will be to produce a larger area of wetland habitat, similar to that in existence at Woodtick Peninsula, which will allow for recolonization by mussels (native and non-native) over the lifespan of the project. However, the creation of artificial reefs associated with Alternatives 3 and 5 will likely lead to an increase in the abundance of dreissenid mussels, as these species were more dominant on hard substrates (Wilson et al., 2006). This colonization of the artificial reefs by dreissenids would lead to a macroinvertebrate community defined by deposit-feeding organisms, small gastropods, and predatory invertebrates, which differ from that of a native mussel community on hard substrate (Ricciardi et al., 1997).

Combined the environmental consequences of the alternatives would likely impact the invertebrate community through mortality and displacement of existing and adjacent communities during construction and then re-colonization of the project area with a community that is different in structure and function (Henley et al., 2000). It is very likely that non-native dressenid mussels will be the primary component of the re-colonizing community, including on artificial reefs if constructed. The presence of dressenid mussels will impact the aquatic macroinvertebrate community but not the insect community which should return to a similar state over the lifespan of the project.

4.3.2.3 Birds

Direct impacts to the bird community of Woodtick Peninsula include disruption of activity at Woodtick Peninsula as a result of construction work. Birds would likely avoid the area where construction equipment was located, and associated feeding and nesting would be similarly disrupted through the prey avoidance of the area and loss of in-water feeding areas. Nesting activities that may occur on the adjacent peninsula may similarly be disrupted by the additional construction traffic and noise during construction. The re-establishment of SAV over the lifespan of the project will increase the available in-water habitat units for birds. This will primarily be an indirect effect as it will take time for the SAV community to regain its structure and function (See Section 4.3.1.2).

Alternatives 3 and 5 will also create new emergent wetland habitat that will be planted with native species. This will directly increase available habitat on Woodtick Peninsula for birds and potentially increase the richness of bird species on Woodtick Peninsula (Robichaud and Rooney, 2017). Without active management of this area, however, it is likely that non-native common reed (*Phragmites spp.*) would outcompete native species over the lifespan of the project (indirect effect). A shift in the vegetation from non-*Phragmites* to one dominated by *Phragmites* would not affect the richness of the bird community, but rather decrease bird abundance and lead to a different bird community composition than one dominated by native plant species (Robichaud and Rooney, 2017).

Western Lake Erie contains high-priority wetlands for marsh birds (Grand et al., 2020), which includes Woodtick Peninsula given the lack of development and distance from urban centers (Tozer, 2016) and its habitat area being adjacent to Erie Marsh (Steen et al., 2006). The environmental consequences of the Alternatives will likely be disruption of bird abundance and use of Woodtick Peninsula habitat during construction, followed by a return and re-use of Wootick Peninsula for both permanent and migratory bird habitat. As the submergent wetlands, and planted emergent wetland in Alternatives 3 and 5, regain full ecological structure and function a greater richness and abundance of bird species will occur in conjunction with bird use of the Woodtick wetlands (Steen et al., 2006).

Bald eagles are documented as roosting and nesting in the project area. As such, the action alternatives have the possibility of disturbing bald eagles as outlined in the Bald and Golden

Eagle Protection Act and Migratory Bird Treaty Act. The Alternatives would fall under Category B Temporary Impacts according to the National Bald Eagle Management Guidelines (USFWS, 2007). As such, avoidance measures and distance will be coordinated with the USFWS and incorporated into any plans and specifications for the selected Alternative. This coordination, and the results thereof, will serve as appropriate mitigation under the Bald and Golden Eagle Protection Act and Migratory Bird Treaty Act.

4.3.2.4 Reptiles and Amphibians

The direct impacts of the Project Actions will likely result in avoidance of the project area by reptiles and amphibians. The proposed dredged material placement areas for all action alternatives will provide adequate access to high quality habitat, adjacent to the project actions (Hunt et al., 2013). Individuals that do not leave the project area will likely experience decreased physiological function, survival, feeding success, and predator avoidance (Calderon et al., 2019).

Indirect impacts of the project construction include the expansion of submergent and emergent wetland habitat. This will provide more non-urbanized wetland habitat that has limited influence from anthropogenic development (Hunt et al., 2013; Calderon et al., 2019). As such, the environmental consequences of the alternatives with respect to reptiles and amphibians will be short term disruption and potential decrease in survival followed by the expansion of a functioning wetland capable of supporting a high richness and diversity of Great Lakes reptile and amphibian species (Hecnar, 2004; Weiten et al., 2012).

4.3.2.5 Mammals

Direct impacts from Project Actions would be primarily restricted to the long obligate wetland mammal in the project area, which are muskrats. All other mammals would either avoid or leave the project area during construction activity. Muskrat themselves would also avoid construction equipment but stay within their established range, some of which fall within the project area.

Given that muskrat primarily feed on aquatic vegetation, the placement of dredged material on the leeward side of the Peninsula would bury and kill SAV, which is currently serving as the primary food source for muskrat (indirect effect). This would cause the muskrat to switch to a more omnivorous diet, move into other muskrats' territories to gain access to food, or die through starvation.

The re-colonization and re-establishment of SAV over the lifespan of the project would increase the available SAV and EAV habitat to support muskrat. Therefore, muskrat would be expected to continue to inhabit the Woodtick Peninsula wetlands following completion of the project actions. Depending on the establishment of each muskrat's range, the project actions have the potential to support a greater number of muskrat or increase survival of young through greater access to food and more available food (in the form of SAV).

Therefore, the environmental consequences of the alternatives with respect to mammals are expected to be short-term negative direct and indirect impacts to muskrat populations at

Woodtick Peninsula followed by positive impacts over the lifespan of the project. This project will not have any long-term negative consequences on muskrat populations and may provide a slight positive impact over the lifespan of the project.

4.3.3 Existing Terrestrial and Aquatic Habitats

All action alternatives will have the direct impact of negatively impacting existing submergent wetlands during dredged material placement followed by an increase in quality habitat through increasing bottom elevations in the submergent zone, and an increase in emergent wetlands for acreages for Alternatives 3 and 5. Alternatives that include the creation of artificial reefs will also produce additional hard-bottom habitat currently only found adjacent to Woodtick Peninsula but not within the project area. As such, the primary environmental consequences of the action alternatives will be the preservation and expansion of a Great Lakes coastal marsh capable of supporting a high diversity of native species (TNC, 2012) in both terrestrial and aquatic environments (Jude and Pappas, 1992).

These environmental benefits of the Alternatives will be reflected in an increase in the L-QHEI scores with the project area. The aquatic habitat quality score will increase through the expansion of submerged wetland habit and colonization by aquatic vegetation. This expansion combined with the preservation of the existing marsh and peninsula (and creation of artificial reef habitat in alternatives 3, 4, and 5) will increase the cover type score. The additional benefits of the expansion of native terrestrial vegetation in Alternatives 3 and 5 will not be reflected in the L-QHEI score expect through elements of the adjacent shoreline being reflected in multiple L-QHEI categories (OEPA, 2010).

4.4 ENDANGERED AND THREATENED SPECIES

4.4.1 Indiana Bat

Indiana bats may be directly impacted due to project actions, including interactions with equipment, while foraging and flying. Since bats are mobile, their primary reaction to these activities will be avoidance of the project area or equipment, which will minimize the impact to their population. No trees are going to be cut and no equipment will be working on Woodtick Peninsula itself for project actions, which will not impact the roosting availability or behavior within or near the peninsula.

Indirect effects may include impacts to foraging success positively, negatively, or in combination. Prey insects may be attracted by the increase in ambient lighting if construction activities occur at night, which could concentrate prey and increase foraging success. This temporary increase in light may also allow for insects to better avoid predation, reducing foraging success near to the construction activity. Both of these impacts could occur simultaneously, resulting in no significant change in foraging success.

The Indiana bat was Federally listed as Endangered on March 11,1967, wherever found. It is also listed in the State of Michigan as an Endangered Species. The determination for the Indiana bat is based on the following rationale:

1. No know hibernacula (locations where bats hibernate) occur near the project site;
2. Designated critical habitat for the Indiana Bat do not occur in the States of Michigan or Ohio;
3. No trees will be cut as a result of project actions;
4. Ambient light will only increase temporarily if construction activities occur at night, and;
5. Bats are mobile and capable of avoiding objects and equipment.

As such, the determination for the Indiana Bat is "**May affect, not likely to adversely affect**" (Appendix E).

4.4.2 Northern Long-Eared Bat

Northern long-eared bats may be directly impacted due to project actions, including interactions with equipment while foraging and flying. Since bats are mobile, their primary reaction to these activities will be avoidance of the project area or equipment, which will minimize the impact to their population. No trees are going to be cut and no equipment will be working on Woodtick Peninsula itself for project actions, which will not impact the roosting availability or behavior within or near the peninsula.

Indirect effects may include impacts to foraging success positively, negatively, or a combination. Prey insects may be attracted by the increase in ambient lighting if construction activities occur at night, which could concentrate prey and increase foraging success. This temporary increase in light may also allow for insects to better avoid predation, reducing foraging success near to the construction activity. Both of these impacts could occur simultaneously, resulting in no significant change in foraging success.

The northern long-eared bat was Federally listed as Threatened on May 4, 2015 wherever found. It is also listed in the State of Michigan as a Species of Special Concern. The determination for the Northern Long-eared bat is based on the following rationale:

1. No know hibernacula (locations where bats hibernate) occur near to the project site;
2. There is no designated critical habitat for the Northern Long-eared Bat;
3. No trees will be cut as a result of project actions;
4. Ambient light will only increase temporarily if construction activities occur at night, and;
5. Bats are mobile and capable of avoiding objects and equipment.

As such, the determination for the Northern Long-eared Bat is "**May affect, not likely to adversely affect**" (Appendix E).

4.4.3 Piping Plover

The piping plover is a designated endangered species both Federally and in the State of Michigan. Critical habitat for this species in the Great Lakes, was designated on May 7, 2011. As such, the piping plover is managed under the authority of the Federal Endangered Species Act of 1973 (ESA; PL 93-205, as amended) as well as the Michigan Department of Natural Resources under the Natural Resources and Environmental Protection Act of 1994. The determination for the Piping Plover is based on the following rationale:

1. The project area is a natural peninsula that meets some of the habitat requirements of piping plover (i.e. sandy beach, gravel or pebble substrate, little or no vegetation);
2. The project location is outside of designated critical habitat for piping plover in the Lake Erie;
3. No piping plover has been observed in or near the project area,
4. Raptors have been observed in the project area that may prey on piping plover (adults and hatchlings; USFWS, 2020), and;
5. The project objectives will not result in the modification or creation of piping plover habitat.

Furthermore, other areas of Lake Erie have suitable habitat, and are designated as critical habitat for the Piping Plover. As such, the determination with respect to piping plover is "**No Effect**."

4.4.4 Red Knot

The red knot was Federally listed as Threatened wherever found on January 12, 2015. It is not listed in the State of Michigan, though its listing has been recommended. The determination for the red knot is based on the following rationale:

1. Red knots have been observed in western Lake Erie near to the project site but very infrequently;
2. Western Lake Erie only serves as stopover habitat on a seasonal basis;
3. Red knots do not have designated critical habitat in the Great Lakes, and;
4. Project actions would not result in any impacts to red knot habitat or food.

Due to this rationale, the determination for the red knot is "**No Effect**."

4.4.5 Eastern Massasauga

The eastern massasauga was Federally listed as Threatened wherever found on September 30, 2016. It is also listed as a species of special concern in the State of Michigan. The determination for the Eastern Massasauga is based on the following rationale:

1. Eastern massasauga have not been observed in the project area or county;

2. The project area is best classified as southern wet meadow habitat, which is not the primary habitat for this species, and;
3. Project actions would take place in-water during the summer and fall and therefore not disrupt any active hibernation.

As such, the determination for the Eastern Massasauga is "**No Effect**."

4.4.6 Northern Riffleshell

The northern riffleshell was Federally listed as Threatened whenever found on January 22, 1993 and is also listed as endangered in the State of Michigan. The determination for the northern riffleshell is based on the following rationale:

1. Woodtick Peninsula, the adjacent wetlands, and western Lake Erie basin do not contain habitat or stream features typical for the species;
2. Mussel surveys have not observed any live individuals in either the Detroit or Maumee Rivers since 1990 and 2009, respectively, and;
3. The northern riffleshell is particularly sensitive to disturbances in habitat and water chemistry;
4. Multiple non-native species now occur in western Lake Erie that could prevent or limit the expansion or re-introduction of the northern riffleshell.

As such, it is not expected that any populations of the northern riffleshell occur within the project area or would be able to re-establish as a result of project actions. Therefore, the determination for the northern riffleshell is **"No Effect."**

4.4.7 Rayed Bean

The rayed bean was Federally listed as Endangered wherever found on March 15, 2012. It is also listed as Endangered in the State of Michigan. The determination for the rayed bean is based on the following rationale:

1. The project area in Woodtick Peninsula has limited habitat typical for this species;
2. The last reports of the rayed been in this geographic area are from 1984;
3. The Final rule for an Endangered Determination for the rayed bean indicates that the rayed bean is considered eliminated in Lake Erie;
4. The non-native zebra mussel, which led to the elimination of the rayed bean from Lake Erie, still persists in Lake Erie and was observed at Woodtick Peninsula in 2021;

5. Identified populations of rayed bean are functionally disconnected from western Lake Erie, preventing or limiting their expansion or re-introduction, and;
6. The species as a whole is imperiled, and continues to decline where still extant.

For these reasons, it is highly unlikely that any rayed bean will be present in or adjacent to the project area, nor would recruitment of new individuals occur during the proposed actions. The determination for the rayed bean is, therefore, **"No effect."**

4.4.8 Karner Blue Butterfly

The Karner Blue Butterfly is a Threatened species in the State of Michigan that is also listed as Endangered wherever found at the Federal Level. When listed on December 14,1992, no critical habitat was included for this species, and none has been designated since that time. The determination for the Karner Blue Butterfly is based on the following rationale:

1. Woodtick Peninsula is not oak savannah habitat and no wild lupine has been documented at this site;
2. The most recent observations of Karner Blue in Monroe County were reintroduced individuals at Petersburg State Game Area, ~20 miles to the northwest, in 2008, and;
3. Karner Blue are known for being poor fliers with limited ranges and population expansion or distribution.

As a result, the determination for the Karner Blue Butterfly is **"No effect."**

4.4.9 Eastern prairie fringed orchid

The eastern prairie fringed orchid was federally listed as Threatened wherever found on September 28,1989 and is also listed as Endangered within the State of Michigan. No critical habitat has been designated for this species, however its endangered status within Michigan affords it extra protections within the State, even on private lands. The determination for the eastern prairie fringed orchid is based on the following rationale:

1. Woodtick peninsula contains habitat that meet the requirements for this species;
2. Field surveys of the project area indicate wetland habitat is dominated by woody growth or the common reed (*Phragmites spp.*);
3. No active land management measures that create disturbances or retard community succession regularly occur;
4. Populations within the Lake Erie prairies are known to naturally fluctuate more than other populations, and ;
5. The status of hawkmoth pollinator populations is not known for the project area.

While there have not been recent surveys of Woodtick Peninsula to determine if any eastern prairie fringed orchids are currently present, the project actions will not result in any impacts to

potential habitat for this species in the project area. As such, the determination for the eastern prairie fringed orchid is **"Not likely to adversely affect."**

4.5 RECREATIONAL, SCENIC, AND AESTHETIC RESOURCES

Recreational vessels using the waters surrounding Woodtick Peninsula would not experience negative impacts from the No Action Alternative or any of the action alternatives. Recreational vessels can easily avoid the areas proposed for dredging and in-water placement and would still be able to traverse along the leeward side of the Peninsula as the design will preserve ~3 feet of depth, which is sufficient for most recreational vessels. The implementation of any action alternatives would not impact areas that are known to be popular for recreational vessels to congregate. Most Lake Erie is navigable for recreational vessels, so transits are unlikely to be impeded during project construction. There will be no changes to recreational vessel use from the proposed modifications, and no impacts to recreation are anticipated.

The western coast of Lake Erie is an important area for recreational users such as bird watchers, hunters, and for fishing. Construction would limit access to the project area, but not to surrounding wetlands. Therefore, impacts to visitor experience of western Lake Erie is not anticipated as impacts to wildlife that is enjoyed by recreational users would be minimized.

4.6 CULTURAL RESOURCES

Due to the known cultural history of the area, density and significance of sites previously identified in the North Maumee Bay, and lack of recent investigations on the Woodtick Peninsula, the USACE is currently conducting a Phase I terrestrial and underwater archeological survey for the Woodtick Peninsula landform and the water bodies adjacent to it to identify archeological sites that may be impacted by the proposed project.

4.6.1 Alternative Analysis

Based on previously recorded archeological sites and initial findings from the Phase I terrestrial survey that began in November 2021, the USACE has considered the impact the alternatives may have on archeological sites thus far identified on Woodtick Peninsula

4.6.1.1 Alternative 1-No Federal Action.

With no federal action, erosion will continue to impact archeological sites and cultural resources on Woodtick Peninsula.

4.6.1.2 Alternative 2A and 2B-Rebuild Peninsula.

For this alternative, impacts to terrestrial cultural resources could be avoided as long as work takes place from the water and does not cause ground disturbance in shoreline areas that contain cultural resources. The impact on any underwater cultural resources is not known at this time as the underwater survey is not complete.

4.6.1.3 Alternative. 3- Rebuild Peninsula and Lakeside Reef.

For this alternative, impacts to terrestrial cultural resources could be avoided as long as work takes place from the water and does not cause ground disturbance in shoreline areas that have been identified as containing cultural resources. The impact on underwater cultural resources is not fully known at this time as the underwater survey is not complete. Specific measures for avoidance, minimization, and mitigation of impacts the artificial reef would have on underwater resources cannot be determined at this time as identification of these resources has not been completed, though there is known archeological information that indicates there is chance that these resources exist in the project's in-water working area. Based on recorded locations of previously identified sites, there is a chance that extant material of an eroded site exists underwater within the footprint of or adjacent to the proposed lakeshore reef. If there is extant material or other underwater cultural resources identified within the proposed footprint of the artificial reef, both in-water construction activities and placement of the reef do pose a risk to these resources, should they exist.

4.6.1.4 Alternative 4A and 4B- Southern Placement of Dredged Material and Offshore Reef.

For this alternative, impacts to terrestrial cultural resources could be avoided as long as work takes place from the water and does not cause ground disturbance in shoreline areas have been identified as containing cultural resources. The impact on underwater cultural resources is not fully known at this time as the underwater survey is not complete. Specific avoidance, minimization, and mitigation of impacts the artificial reef would have on these resources cannot be determined at this time as identification of underwater resources has not been completed, though there is known archeological information that indicates there is chance that these resources exist in the project's in-water working area. Based on recorded locations of previously identified sites, there is a chance that extant material of an eroded site exists underwater within the footprint of or adjacent to the proposed offshore reef. If there is extant material or other underwater cultural resources identified within the proposed footprint of the artificial reef, the in-water construction activities and placement of the reef does pose a risk to these resources, should they exist.

4.6.1.5 Alternative 5- Southern Placement of Dredged Material and Two Offshore Reef.

For this alternative, impacts to terrestrial cultural resources could be avoided as long as work takes place from the water and does not cause ground disturbance in shoreline areas that contain cultural resources. The impact on underwater cultural resources is not fully known at this time as the underwater survey is not complete. Specific avoidance, minimization, and mitigation of impacts the artificial reefs would have on these resources cannot be determined at this time as identification of underwater resources has not been completed, though there is known archeological information that indicates there is chance that these resources exist in the project's in-water working area. Based on recorded locations of previously identified sites, there is a chance that extant material of two eroded sites exist underwater within the footprint of or adjacent to the proposed lakeshore and offshore reefs. If there is extant material or other

underwater cultural resources identified within the proposed footprint of the artificial reefs, the in-water construction activities and placement of the reefs does pose a risk to these resources, should they exist.

Table 12: Potential impacts on cultural resources

Alternative	Potential impact to terrestrial cultural resources	Potential impact to underwater cultural resources
Alt. 1-No Federal Action	High	Unknown
Alt. 2a-Rebuild Peninsula	Medium	Unknown
Alt 2b-Rebuild Peninsula	Medium	Unknown
Alt 3-Rebuild Peninsula+Lakeside Reef	Medium	Low- Tentative
Alt 4a-Place Dredged Material+Offshore Reef	Medium	Low-Tentative
Alt 4b- Place Dredged Material+Offshore Reef	Medium	Low- Tentative
Alt 5- Dredged Material+Lakeside Reef+Offshore Reef	Medium	Low- Tentative

4.6.2 Current Archeological Investigation Status

Due to weather conditions from November 2021 through March 2022 that has prohibited underwater survey work, the assessments above incorporate potential impacts to underwater cultural resources, should they be present.

Due to high water levels and resulting inundation of the Woodtick Peninsula landform during the winter season, only 38.3 terrestrial acres have been surveyed to date. The surveys done in these areas are included in the initial assessment above. It is expected that the spring season will allow for an additional 15 acres to be surveyed, however a total of 294.6 acres of Woodtick Peninsula are not surveyable. The archeological investigations are expected to be fully completed by spring 2022.

4.6.3 Section 106 Status

4.6.3.1 Tribal Consultation

Following the USACE's identification of Woodtick Peninsula as part of a NRHP-listed archeological district with Woodland and Archaic sites previously recorded and need for Phase I archeological survey, in March 2021 the USACE reached out to the following eleven Federally Recognized Tribes regarding the survey, seeking input of any sites that may not have been recorded during previous excavations, and invitation to consult under Section 106 of the National Historic Preservation Act (NHPA):

Forest County Potawatomi of Wisconsin
Hannahville Indian Community
Lac du Flambeau Tribe of Lake Superior Chippewa
Little Traverse Bay Band of Odawa
Menominee Tribe of Wisconsin
Miami Tribe of Oklahoma
Ottawa Tribe of Oklahoma
Pokagon Band of Potawatomi
Saginaw-Chippewa Tribe of Michigan
Sault Ste. Marie Tribe of Chippewa
Seneca-Cayuga Nation

Of these Tribes contacted, the Pokagon Band of Potawatomi and Miami Tribe of Oklahoma responded to be consulted on impacts the project may have on archeological resources identified during the survey. As the Michigan Department of Natural Resources (MDNR) processed the archeological survey permit, as the State landowner, the Match-e-be-nash-she-wish (Gun Lake) Band of Potawatomi identified themselves as a consulting party under Section 106.

4.6.3.2 Consulting Parties

Given initial results from the field, the USACE is consulting with the following parties to assess potential impacts and how to avoid, minimize, or mitigate these impacts as the TSP is designed, under 36 CFR 800.4.d.2 and 36 CFR 800.5:

Michigan Department of Natural Resources (MDNR)
Michigan State Historic Preservation Office (SHPO)
Match-E-Be-Nash-She-Wish Band of Potawatomi Indians (Gun Lake Tribe)
Miami Tribe of Oklahoma
Pokagon Band of Potawatomi

The USACE has consulted with the parties identified above in early March 2022 to provide information on the status and initial findings of the survey.

4.6.3.3 Future Actions

Once the surveys are completed and archeological sites, both terrestrial and underwater, are identified pursuant to 36 CFR 800.4, the USACE will consult with the five consulting parties

noted above to assess if the TSP will have "no adverse effect" or an "adverse effect" on the identified archeological sites. Once a determination of effect has been made in consultation with these parties, the USACE will furnish the determination of effect to the eleven Tribal parties initially contacted to consult, the SHPO, and the MDNR. Should the USACE determine that the TSP will have an "adverse effect" on eligible historic properties, the USACE will work to resolve these effects in consultation with the above parties, pursuant to Section 106 of the NHPA and through the development of a Memorandum of Agreement (MOA). A final determination of effect and subsequent mitigation measures, should such measures be needed following consultation, will be included in the Findings on No Significant Impact (FONSI).

4.7 AIR QUALITY

Direct impacts of the action alternatives will include the presence of construction equipment using internal combustion engines that will produce exhaust during transit and construction activities. This will likely result in temporary reduction in air quality at and surrounding the site at the beginning of the project during construction. All equipment would be required to meet emission standards of the Clean Air Act. Following completion of dredge material placement, normal recreational, commercial, and regulatory traffic at the site will resume and is expected to be similar to levels that currently occur. As such, the action alternatives are not anticipated to affect the site's air quality over the lifespan of the project.

4.8 NOISE

The Occupational Safety and Health Administration (OSHA) considers a typical construction site to produce a noise level of 100 decibels (dB). Construction noise in this instance would be considered a point source on a hard site (NRC). A standard attenuation coefficient for a construction site with these characteristics is 6 dB for each doubling of distance from the point source noise (in feet). The closest communities to the site are Shoreland and Point Place communities in Ohio to the southwest near Lost Peninsula (Erie, MI) which are greater than 1.5 miles away. These communities may be exposed to some noise from the construction activities but are at a distance that no risk to health or safety would be expected. Following completion of construction activities, noise would return to background pre-project levels to include natural lake/water, wildlife calls, and boaters. No significant or long-term impacts are expected resulting from noise generated as part of the alternatives.

4.9 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE

The No Action Alternative would have no effect on Environmental Justice and existing conditions would be expected to remain unchanged.

All action alternatives would not result in disproportionately high or adverse human health or environmental effects on minority or low-income populations. The area affected by the recommended plan is all within Lake Erie near Woodtick Peninsula, which is a state recreation area. Therefore, there is no minority and low-income population within the project area. The action alternatives are, however, expected to provide many benefits to the local demographic

such as enhanced fish and wildlife resources, enhanced aesthetics, and greater recreational opportunity. As such, there would be no disproportionately high or adverse human health or environmental effects on minority or low-income populations.

4.10 CLIMATE CHANGE

The Great Lakes basin has already seen evidence of climate change as more intense storms result in more frequent and damaging floods, interspersed with lengthy periods of dry weather, as well as increasing lake water temperatures and reduced amounts and duration of ice cover in winter. The recent (2019 to early 2021) near-record high water levels on the Great Lakes has contributed to significant erosion throughout the Great Lakes, including Lake Erie. This has undoubtedly contributed to a period of greater-than-average erosion of Woodtick Peninsula. Taken at face value, the projected Regional Climate Models that provide input to Net Basin Supplies for the Great Lakes Basin largely indicate a general (minor) decline in water levels throughout the basin (except for some outcomes) through mid-century. However, as stated in the Climate Assessment for this report, drastic swings in water levels throughout the basin, as witnessed in the last decade, could be the 'new normal' for the Great Lakes.

While it is impossible to predict when and where within the Great Lakes basin that more frequent and/or higher-intensity storms may occur, there appears to be an increasing trend of more intense storm systems (in both terms of precipitation and wind) across the Great Lakes and upper Midwest, especially during the transitional seasons of spring and fall. Combining this trend with the USACE Vulnerability Assessment tool indications of greater runoff and potential flood magnification into the future, there is a signal that storm intensity will continue to increase across the Great Lakes through the 21st century.

As such, implementation of any of the 'action alternatives' listed in this report would help to increase the resiliency of Woodtick Peninsula against the vulnerabilities identified in the Climate Assessment. However, the greatest vulnerability identified would be a condition of persistent high/record high Lake Erie water levels, pared with recurring strong storms that create powerful waves. This scenario would undoubtedly threaten any restoration efforts, and possibly the existence of the Peninsula itself.

Potential adaptation strategies to address these vulnerabilities include placing additional dredged material on the peninsula to increase its resiliency, monitoring the condition of the peninsula, and providing occasional re-nourishment from future dredging operations in the Maumee River. Additionally, to mitigate against higher air and water temperatures for the channel restoration measure, a variable-depth channel adjacent to the vegetated shoreline may afford some level of protection for fishes and other aquatic wildlife. This may also help to mitigate for a large range of future Lake Erie water levels.

Table 13: Residual Risk Due to Climate Change Woodtick Peninsula

Feature or Measure	Trigger	Hazard	Harm	Qualitative Likelihood
Rebuilding Woodtick Peninsula	More intense storms, with high Lake Erie water levels	Increased erosion and possibly wave over-wash	Loss of placed sediment, and loss of restored habitat on and behind peninsula	Moderate, although indications are for lower future levels, more intense storms would increase erosion
Channel Restoration	Increased sedimentation	In the Navigation Business Line, Flood Magnification is shown to increase, which would increase sediment loading	Buried or altered habitat; erosion/ scour in places due to increased flows from the Ottawa River	Low, as the primary flow to western Lake Erie comes from the Maumee River, and those flows are directed southeast of Woodtick
Channel Restoration/ Erie Marsh	Higher air and lake water temperatures	Alteration of habitat from native to invasive; vulnerability to freshwater plants.	Habitat value could decrease and not support desired aquatic species.	Moderate, as the mean temperature of the Great Lakes is already shown to be increasing.

4.11 17 POINTS OF ENVIRONMENTAL QUALITY

The 17 Points of Environmental Quality are defined by Section 122 of the Rivers, Harbors, and Flood Control Act of 1970 (Public Law, PL 91-611). Effects to each of the 17 points resulting from the proposed Alternatives are discussed below.

4.11.1 Noise

The proposed alternatives will create noise beyond ambient levels of which are typical of Woodtick Peninsula. These noises will be temporary in nature and duration and limited to construction activities during the beginning stages of the project. At the completion of construction, all noise would return to ambient levels experienced currently.

4.11.2 Displacement of People

The proposed Alternatives would not displace any residents.

4.11.3 Aesthetic Values

Any of the proposed action alternatives would temporarily alter the physical appearance of the waters submergent wetlands (and emergent wetlands for Alternatives 3 and 5). These ecosystems

are expected to experience natural succession to achieve a state similar to existing conditions. Therefore, the project will not have any long term negative impacts on the aesthetic nature or value of Woodtick Peninsula.

4.11.4 Community Cohesion

The proposed alternatives would not disrupt or alter community cohesion. It will indirectly support community cohesion of the Great Lakes through the use of material removed from the Toledo Harbor Federal Navigation Channel, maintaining and supporting maritime industry and connectivity.

4.11.5 Desirable Community Growth

The proposed alternatives would maintain a high value wetland in western Lake Erie that is adjacent to a USEPA listed Area of Concern. This wetland supports commercial and recreational industry in the area while also promoting a healthy ecosystem that feeds into western Lake Erie, which is used as a drinking water source for the City of Toledo. As such, this project will maintain a desirable ecosystem that supports community growth through commercial and recreational use of natural resources found at, or supported by, Woodtick Peninsula.

4.11.6 Desirable Regional Growth

The proposed alternatives would maintain a high value wetland in western Lake Erie that also serves as a barrier peninsula for adjacent wetlands that are owned and operated by The Nature Conservancy. The natural resources at, or supported by, Woodtick Peninsula also feed local and regional commercial and recreational ventures. Therefore, the proposed Alternatives would support desirable reginal growth by keeping expanding one of the few remaining such wetlands in the Great Lakes. Use of material dredged from the Toledo Harbor Federal Navigation Project would serve to maintain and enhance reginal growth in western Lake Erie through the maintenance of Great Lakes navigation.

4.11.7 Tax Revenues

The proposed alternatives would have no adverse effect on tax revenues. Recreational and commercial benefits of Woodtick Peninsula may provide a beneficial impact to tax revenues both locally and regionally, including through the sale of hunting, trapping, and fishing permits. The maintenance of the Toledo Harbor Federal Navigation Project will support the generation of tax revenues associated with maritime shipping and commercial and recreational use of Toledo Harbor. As such, the proposed Alternatives are likely to have a positive benefit on tax revenues.

4.11.8 Property Values

Woodtick Peninsula provides ecosystem, recreational, natural resource, and aesthetic benefits to the Maumee Bay area and Lake Erie. The proposed Alternatives would maintain these benefits, and any benefits they directly or indirectly provide to adjacent properties. Furthermore, its function as a barrier wetland serves to protect the physical integrity of Erie Marsh, providing a positive impact to its property value through the reduction and protection from natural forces such as erosion.

4.11.9 Public Facilities

Woodtick Peninsula is a component of the Erie State Game Area, a Game Area managed by the MDNR in which hunting and fishing can occur. In this respect, the entirety of the Peninsula and adjacent submergent wetlands are a public facility. The Alternatives would therefore directly benefit this public facility through direct improvements to its structure and function, while providing and indirect benefits to its longevity and resilience. The use of material dredged from the Toledo Harbor Federal Navigation Project would support the maintenance and operation of maritime navigation in Lake Erie and the Great Lakes.

4.11.10 Public Services

Woodtick Peninsula, as a component of Erie State Game Area supports the public services of the Michigan DNR. Indirect benefits to the water quality of Lake Erie support the public services of the City of Toldeo, which uses Lake Erie to provide drinking water to the City. As such, the Alternatives would support the valuable public services of two different States and their citizens. The project's use of material from the Toledo Harbor Federal Navigation Project will support a public service of maritime navigation on the Great Lakes and the Maumee River.

4.11.11 Employment

The proposed alternatives are expected to have short term beneficial impacts to employment. A direct benefit to employment would be the need for additional construction workers needed for the material placement operations. A healthy wetland ecosystem may provide an indirect benefit for employment opportunities in commercial and recreational hunting, fishing, trapping, birding, and boating industries, including employment in operations such as sporting goods stores, charter and guide services, and marinas. Indirect benefits to employment will be realized through the support of maintenance of the Toledo Harbor Federal Navigation Channel which is an important element of business regionally and throughout the Great Lakes.

4.11.12 Business and Industrial Activities

The proposed alternatives are expected to have no effect or some minor benefit to businesses associated with natural resources and outdoor activities, such as marinas and sporting goods stores. Indirectly, the use of material from the Toledo Harbor Federal Navigation Project will support business and industrial activities regionally, throughout the Great Lakes, and internationally by providing for save transport and exchange of goods, and passage through, the Great Lakes.

4.11.13 Displacement of Farms

The Farmland Protection Policy Act is designed to reduce or minimize the impact of Federal programs on permanently converting farmland for nonagricultural purposes and uses. The Farmland Protection Policy Act includes prime and unique farmland, state or local lands of importance, forests, pastures, and other land but excludes water and urban lands. Given that the project area for this project is entirely in the waters of Lake Erie on property owned by the State

of Michigan, no lands covered by the Farmland Protection Policy Act will be impacted by the proposed Alternatives.

4.11.14 Man-made Resources

Woodtick Peninsula is a natural resource that also serves as a barrier peninsula for other natural areas. Erie Marsh has had some man-made improvements and armoring done (in the form of rip-rap shoreline armoring). Therefore, the project goal of restoring and improving the wetlands of Woodtick Peninsula would serve to further protect the man-made components of Erie Marsh. The Toledo Harbor Federal Navigation Project is a man-made resource that includes the Federal Navigation Channel, breakwater structures, and turning basins for commercial shipping traffic. The proposed Alternatives will provide maintenance and benefit to the man-made resource of Toledo Harbor through the support of maintenance activities intended to maintain the operational capacity of the Harbor.

4.11.15 Natural Resources

Woodtick Peninsula and the adjacent wetlands are one of 34 unique habitat areas in the North American Waterfowl Management Plan (USFWS, 1986) and one of 43 areas of greatest continental significance to North American ducks, geese, and swans (USFWS, 2012). They are also considered a site of regional importance in the Western Hemisphere Shorebird Reserve Network (WHSRN, 2021). As such, the project is intended to restore and expand this natural resource, yielding a net benefit to the natural resources of this area (See Section 4).

4.11.16 Air Quality

Construction activities would have temporary, minor negative impacts on air quality in the air immediately surrounding the Vessel Yard. All equipment would be required to meet emission standards. As such, all emissions from the proposed activities would meet applicable standards of the Clean Air Act.

4.11.17 Water Quality

The proposed alternatives would not result in significant adverse effects on water quality, including municipal and private water supplies. No significant adverse effects to the aquatic ecosystem in the areas of diversity, productivity, stability, recreation, aesthetic, and economic value would occur. Appropriate steps will be taken to minimize the adverse effects on the water quality at the proposed site included the use of uncontaminated dredge materials, use of environmental controls, and project coordination with the MDNR, EGLE, USFWS, and TNC. A 401 Water Quality Certificate will be coordinated with EGLE. On the basis of the "Guidelines for Specification of Disposal Sites for Dredged or Fill Material" (40 CFR part 230), it has been determined that the proposed fill activity is in compliance with Section 404 of the 1977 Clean Water Act (Appendix I).

4.12 RESOURCES CONSIDERED BUT ELIMINATED FROM CONSIDERATION

Additional resources were identified but eliminated from consideration and not carried through the environmental consequence assessment process. These resources were determined to not be

impacted by the project actions, not applicable to the project area, or otherwise not impacted and therefore did not warrant further inclusion.

4.12.1 Prime Farmland

The Farmland Protection Policy Act is designed to reduce or minimize the impact of Federal programs on permanently converting farmland for nonagricultural purposes and uses. The Farmland Protection Policy Act includes prime and unique farmland, state or local lands of importance for the production of food, feed, or similar, and other land but excludes water and urban lands. Given that the project area for this project is a wetland situated in Lake Erie, no lands covered by the Farmland Protection Policy Act will be impacted by the project actions. As such, this resource was excluded from further evaluation.

4.12.2 Food and Fiber Production

Given that the project area is a wetland extending into Lake Erie and will not be converting any agricultural lands for other uses or impacting commercial fishing operations, no impacts are expected to food and fiber production from the project actions. As such, this resource was excluded from further evaluation.

5 TENTATIVELY SELECTED PLAN

Based on the evaluation of the costs, benefits, completeness, effectiveness, and efficiency of each alternative and an analysis of the four accounts (NED, RED, EQ, OSE), Alternative 4A was designated as the TSP. Figure 13 illustrates the project features which include an offshore reef near and dredged material placement on the lee side of the peninsula.

5.1 TENTATIVELY SELECTED PLAN DESCRIPTION

Alternative 4A includes in-water placement of dredged material from Toledo Harbor, OH on the leeside of Woodtick Peninsula. Dredged material would be hydraulically placed to an elevation of 570.75 feet extending away from the peninsula at a 1:20 slope to bottom elevation of 562 feet (Figure 14). This will create approximately 55 acres of new submerged wetland habitat for SAV by increasing the bottom elevation so that a larger area is within the photic zone, for a total SAV bed area of approximately 102 acres.

Figure 13. Tentatively Selected Plan

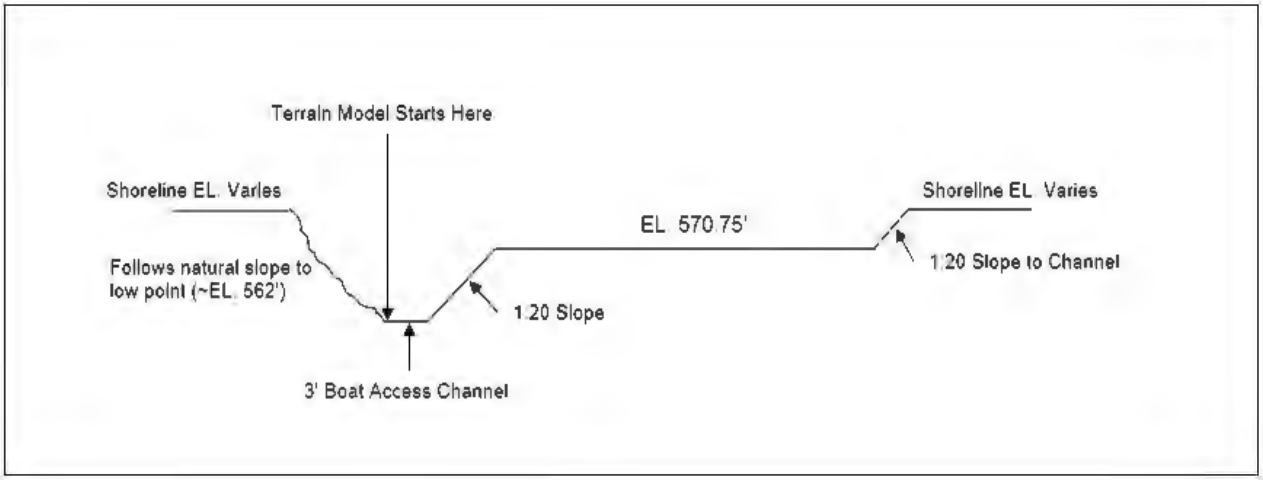

Figure 14. Conceptual cross section of the dredged material placement area

This action also includes creation of an artificial reef made with geosynthetic containers (GSCs) that are filled with dredged material and have stone placed on top to form approximately 1/3 acre of hard-bottom native fish habitat. Stone sizes would range from 6 – 12 inches with some larger 3-feet diameter stone. The reef would be constructed off the southern end of Woodtick Peninsula. The GSCs would be placed in one layer, as a curved line to an elevation of approximately 566.2 – 566.5 feet. This placement depth would keep them below the long term average water depth of 571.42 feet. The reef would be approximately 1200 feet in length, have a footprint of approximately 1/3 of an acre, and require approximately 1200 CY of dredged material. It would likely be partially exposed for part of the year, dependent on water levels. This plan would have a placement footprint of 115.3 acres and require approximately 156,000 CY of dredged material. The anticipated L-QHEI for Alternative 4A is 68, primarily driven by an improvement in the Cover Types and Aquatic Vegetation Quality.

Alternative 4A is expected to make Woodtick Peninsula more resilient to current and future climate change effects by adding more material behind the Peninsula, which will also expand wetlands that will help stabilize the Peninsula. Further, the construction of the reef is expected to alleviate erosion at the southern flank of the Peninsula by reducing scour at that location, as well as potentially capturing suspended sediment. The sloping placement depths of the dredged material will also allow diverse habitat to thrive under variable future water level conditions.

The artificial reef is designed to be sufficient to protect and stabilize placed dredged material to allow for establishment of submerged aquatic vegetation behind the reef structure through the reduction of wave energy and scour in the restoration area (Appendix D). As such, the artificial reef is not included in the ecological benefits or AAHUs calculated for the project as this structure will primarily provide indirect benefits to the wetland ecosystem of Woodtick Peninsula. As the ecological benefits of the TSP are an increase in habitat units driven by the expansion of aquatic vegetation, these benefits should be achieved prior to any degradation to the reef. The artificial reef structure is anticipated to have a lifespan of 15 years. This is due to the

structure being placed at a depth contour where it is expected to be partially submerged, which will expose both the cover armor stone and GSCs to the elements (including sunlight). The armor stone was primarily designed to withstand ice forces of western Lake Erie (Appendix B). The inclusion of smaller 6-12 inch diameter stone in the design may provide some habitat benefit to native species, however this will be less than the total ~1/3 acre of the reef and therefore limit the ecological benefits gained from this structure (Manny et al., 2015). Once the lifespan of the reef is reached, any degradation or loss of associated reef habitat will have a minimal impact on the aquatic habitat due to structural stability and ecosystem benefits provided by the establishment of aquatic vegetation (Sturtevant et al., 2021).

5.2 ESTIMATED PROJECT COSTS AND SCHEDULES

Table 14 and Table 15 (below) show the estimated project costs and estimated implementation schedule. Per Section 204 policy, the non-federal responsibilities are to provide all lands, easements, rights-of-ways, relocations and disposal areas (LERRD's); pay any cash contribution during design, implementation and monitoring necessary so that the total contribution of the non-federal interest, including the value of the LERRD's, will be at 35% of the incremental costs above the costs of the 'Base Plan'; pay 100% of the operations, maintenance, repair, replacement and rehabilitation (OMRR&R) of the completed beneficial use project, and hold and save the Government free from all damages arising from all damages arising from the design, construction, operation, maintenance, repair, rehabilitation and replacement of the project, except for damages due to the fault or negligence of the Government or its contractors.

Table 14. Estimated Project Costs and Apportionment

–	FY2021	FY2022	FY2023	FY2024
Feasibility Study Costs*				
FED share	$531,843	$856,157		
Non-FED				
Design & Implementation Costs				
Design Analyses, Plans & Specs			$250,000	$702,000
Construction				$4,577,000
LERRDS				$57,500
FED share	$531,843	$856,157	$162,500	$ 3,431,350
Non-FED			87,500	$1,847,650
Non-FED cash/WIK	-	-	-	-
Non-FED LERRDS				$57,500
Total Project First Cost			$250,000	$5,279,000
FED share			$162,500	$3,431,350
Non-FED			$87,500	$1,847,650

* Feasibility phase is 100% federal responsibility.

Initially, the Woodtick feasibility study is produced at full federal expense. If this project proceeds into the Design and Implementation phase, the non-federal sponsor is responsible for paying 35% of the construction costs above the 'Base Plan', including Planning and Design work completed before the Project Partnership Agreement (PPA) is signed. This contribution can be through cash payment, or LERRD's credits plus cash. These requirements are presented in more detail in Section 5.3 below.

The recommend plan includes a project first cost (FY22) of $5,529,000 and, when escalated to the mid-point of construction, the fully funded cost is $5,973,000 (FY22). This cost includes construction contractor mobilization/demobilization costs, placing dredged material into the leeside placement area, and constructing the offshore reef.

Table 15 - Implementation Schedule

Milestone	Scheduled	Actual
Initiate Feasibility Phase		Aug 2020
Submit Federal Interest Determination Report		Nov 2020
MSC Approved FID report		Dec 2020
Execute Feasibility Cost Share Agreement*	N/A	N/A
Tentatively Selected Plan	Mar 2022	
Start Public Review and Agency Technical Review	Apr 2022	
Submit Final Feasibility Study	Sep 2022	
LRE Approved Decision Document	Oct 2022	
Project Approval – Initiate D&I Phase	Oct 2022	
Fully Executed Project Partnership Agreement	Mar 2023	
RE Certification	Oct 2023	
ATR Certified Construction Plans & Specifications	Dec 2023	
Construction Contract Award	Apr 2024	
Construction Complete	Dec 2024	
Construction Closeout	Feb 2025	

* Feasibility phase for CAP-204 project is 100% Federally funded.

5.3 NON-FEDERAL SPONSOR RESPONSIBILITIES

The estimated non-Federal share of the total first cost of the project is $1,847,650 and can be covered by a combination of cash and work-in-kind. A Project Partnership Agreement (PPA) will be required from the nonfederal sponsor, under which the sponsor will agree to:

1. Provide 35 percent of the separable project costs allocated to environmental restoration as further specified below
    a) Provide the non-Federal cost share of all complete planning and design work upon execution of the PPA
    b) Provide all lands, easements, and rights-of-way, including suitable borrow and dredged or excavated material disposal areas, and perform or ensure the performance

of all relocations determined by the government to be necessary for the construction and O&M of the project

c) Provide or pay to the government the cost of providing all features required for the construction and O&M of the project

d) Provide, during construction, any additional costs as necessary to make its total contribution equal to 35 percent of the separable project costs allocated to environmental restoration

2. Contribute all project costs in excess of the Federal Statutory Section 204 per-project limit of $10,000,000

3. For as long as the project remains authorized, operate, maintain, repair, replace, and rehabilitate the completed project or the functional portion of the project at no cost to the government in accordance with applicable federal and state laws and any specific directions prescribed by the government

4. Give the government a right to enter, at reasonable times and in a reasonable manner, upon land that the local sponsor owns or controls for access to the project for the purpose of inspection and, if necessary, for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the project

5. Assume responsibility for operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) of the project or completed functional portions of the project, including mitigation features, without cost to the government in a manner compatible with the project's authorized purpose and in accordance with applicable federal and state laws and specific directions prescribed by the government in the OMRR&R manual and any subsequent amendments thereto

6. Comply with Section 221 of Public Law (P.L.) 91-611, Flood Control Act of 1970, as amended, and Section 103 of the WRDA of 1986, as amended, which provides that the Secretary of the Army shall not commence the construction of any water resource project or separable element thereof until the nonfederal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element

7. Hold and save the United States free from damages due to construction of or subsequent maintenance of the project except those damages due to the fault or negligence of the United States or its contractors

8. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project to the extent and in such detail as will properly reflect total project costs

9. Perform or cause to be performed such investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S. Code 9601 through 9675, that may exist in, on, or under lands, easements, or rights-of-way necessary for the construction, and O&M of the project, except that the nonfederal sponsor shall not perform investigations of lands, easements, or rights-of-way that the government determines to be subject to navigation servitude without prior written direction by the government

10. Assume complete financial responsibility for all necessary cleanup and response costs for CERCLA-regulated material located in, on, or under lands, easements, or rights-of-way that the government determines necessary for the construction and O&M of the project

11. To the maximum extent practicable, conduct OMRR&R of the project in a manner that will not cause liability to arise under CERCLA

12. Prevent future encroachment or modifications that might interfere with proper functioning of the project

13. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, P.L. 91-646, as amended in Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987, P.L. 100-17, and the uniform regulation contained in Part 24 of Title 49, Code of Federal Regulations (CFR), in acquiring lands, easements, and rights-of-way for construction and subsequent O&M of the project, and inform all affected persons of applicable benefits, policies, and procedures in connection with said acts

14. Comply with all applicable federal and state laws and regulations, including Section 601 of Title VI of the Civil Rights Act of 1964, P.L. 88-352, and Department of Defense Directive 5500.11 issued pursuant thereto and published in 32 CFR, Part 300, as well as Army Regulation 600-7 entitled "Non-Discrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army"

15. Do not use federal funds to meet the nonfederal sponsor's share of total project costs unless the federal granting agency verifies in writing that the expenditure of such funds is expressly authorized by statute.

5.3.1.1 Views of the Non-Federal Sponsor

The Michigan Department of Natural Resources is supportive of the project and concurs with the recommendation of Alternative 4A as the TSP. They are an able and willing cost share sponsor for the design and implementation of the project.

5.4 LANDS, EASEMENTS, RIGHTS-OF-WAY, RELOCATIONS AND DISPOSAL AREAS

Michigan Department of Natural Resources (MDNR) is the NFS for this project. At this time, all lands needed for implementation are assumed to be either State of Michigan bottomlands or property under the management of the MDNR. Therefore, it is assumed that they will be able to provide all necessary real estate required for the project. As the project is expected to be constructed from the water (via hydraulic dredged) no land-based staging area is expected to be required nor is access via land to the project site expected.

Should it later be determined that an additional real estate interest is required for the project, the MDNR is responsible for providing the lands, easements, and rights-of-way (LER) required to implement the project. See Appendix F for additional detail on real estate related to the project.

5.5 MONITORING AND ADAPTIVE MANAGEMENT

Adaptive management was estimated at 3% of construction costs for analysis purposes. This is approximately $158,000 for the Tentatively Selected Plan. Monitoring will consist of the MDNR repeating the LQHEI survey about five times over a 10 year period. Costs associated with monitoring are estimated at approximately $20,000 over the 10 year period (five sampling events at $4,000 each over 10 years).

Monitoring of the project with respect to the Federal objective of protecting, restoring and/or creating aquatic and ecologically related habitats, including wetlands, will consist of re-assessing the project area using the Lacustuary Qualitative Habitat Evaluation Index (L-QHEI; OEPA, 2010). This method was used in a pre-project site assessment in 2021 to develop the existing conditions as well as determine ecological targets for restoration and Alternative comparison.

The L-QHEI assessment provides a score from 0-100, with 100 being the best, based on five metrics of habitat: substrate, cover types, shoreline morphology, riparian zone and bank erosion, and aquatic vegetation quality. The tentatively selected plan (TSP: Alternative 4A) has a target L-QHEI score of 68, which is an increase from the score of 48.4 assigned by the pre-project site assessment.

The project monitoring will consist of the Michigan Department of Natural Resources repeating the L-QHEI site assessment five times over a 10-year period. Assessment should occur in the first year following project completion and then approximately every other year thereafter until a final assessment in year 10 of the monitoring period (Table 1). If five discreet monitoring events are not possible, it is recommended that a minimum of three be conducted. Two within the first three years of construction completion to determine how quickly the community is responding to the disturbance, and then a third on year 10 to determine if the target L-QHEI score was reached and the overall success of the project.

Table 16: Recommended interval for monitoring of the project area by the MI DNR. Optional sampling event can be postponed to beyond the 10-year monitoring period or cancelled entirely.

Year after construction	Monitoring Event?
1	Summer
2	
3	Summer
4	
5	Summer (optional)
6	
7	Summer (optional)
8	
9	
10	Summer

The L-QHEI assessment should be conducted at all locations previously assessed, which were done at a spacing of approximately every 500m (~1600 feet) within the placement area (Table 17; Figure 8). If locations cannot be accessed from water following construction, the closest point waterward from the identified coordinates should be surveyed and new position noted on L-QHEI sheet. The L-QHEI assessment should focus on the habitat zone towards the peninsula and extending roughly 250m (~800 feet) to the left and right. Monitoring should ideally occur in the summer months, or no earlier than June, to allow for growth of submerged aquatic vegetation since the L-QHEI includes a score for aquatic vegetation quality. Every effort should also be made to conduct monitoring during the same week of the year to minimize differences in aquatic vegetation biomass and quality due to season/climate.

Table 17: Sampling locations for L-QHEI surveys. All coordinates are in decimal degrees.

Station ID	Latitude	Longitude
WP-LQHEI-05	41.76862	-83.4421
WP-LQHEI-06	41.76461	-83.4396
WP-LQHEI-07	41.76057	-83.4375
WP-LQHEI-08	41.75632	-83.4361
WP-LQHEI-09	41.75198	-83.4346
WP-LQHEI-10	41.74819	-83.4364
WP-LQHEI-11	41.74546	-83.432
WP-LQHEI-12	41.74084	-83.4286
WP-LQHEI-23	41.74314	-83.4341

Scores will be calculated individually for each station and then averaged to produce a score representative of the entire project area. This score should be compared to the pre-construction score (48.4) and target score (68) to determine whether the desired outcomes are being realized within the project area. Scores for individual sites should also be compared in a similar manner to determine whether objectives are being realized equally across the site, or in localized areas that may require adaptive management. As part of the LQHEI surveys it will be recommended that the MDNR perform a visual inspection of the reef structure to ensure it is still in place.

5.6 OPERATION, MAINTENANCE, REPAIR, REPLACEMENT, AND REHABILITATION (OMRR&R)

Under the Section 204 authority, it is the responsibility of the non-federal sponsor (MIDNR) to maintain the project after construction. The MIDNR indicated that they are aware of these requirements. There are no expected future OMRR&R costs associated with Alternative 4A.

5.7 PROJECT RISKS

The PDT identified a series of risks related to the feasibility study and project implementation. Key study risks include a delay in the feasibility study schedule due to delays in data collection. Specifically, the archeological survey has been delayed due to weather conditions at the project site. The archeological survey must be completed prior to coordination with the State SHPO office. There is a risk that the TSP may have to change based on the results of the archeological

survey. This risk is considered medium due to TSP features being primarily below the ordinary high water mark. Another feasibility study risk was associated with accessing the study site via land. In order to access Woodtick Peninsula via land, one must cross a parcel of land owned by the Consumer's Energy company. Securing real estate access though this energy companies has been extraordinary difficult. Due to this experience, implementation access from the water is recommended to mitigate the risk of accessing the site via land. Another study risk the team addressed was the risk of creating a project that would be colonized by the invasive species, phragmites. This fast growing invasive weed is prevalent at Woodtick Peninsula. The team mitigated this risk by designing dredged material placement areas to be below the average Lake Erie water level by about six inches. Phragmites do not colonize in areas inundated with six inches of water or greater. This design criteria helps to mitigate the risk of phragmites colonizing the new project areas.

The PDT identified several risks in the design and implementation phase. A key risk relates to the use of geosynthetic containers (GSCs) in the construction of the artificial reef. These GSCs are a relatively new technology to the Great Lakes and new to the Detroit District. There is a chance the GSCs would not perform as intended and have a less than anticipated design life. Since the GSCs would be placed in shallow water, they are likely to be exposed to ice and sun which could impact their design life. In order to mitigate this, the current design includes placing a variety of stone on top of the GSCs to offer them protection and create aquatic habitat. This design will be refined to provide the greatest protection to the GSCs as the project moves through the feasibility phase into the Pre-Construction and Engineering Design (PED) phase. Another implementation risk relates to the NFS acquiring a permit from the State of Michigan for construction. There is a chance that additional sampling will be required in order to satisfy permit requirements.

5.8 ENVIRONMENTAL OPERATION PRINCIPLES

The USACE Environmental Operating Principles (EOPs) are considered throughout the study process and will continue to be part of construction and operation of the recommended plan.

Below are the USACE EOPs:

- Foster sustainability as a way of life throughout the organization.
- Proactively consider environmental consequences of all USACE activities and act accordingly.
- Create mutually supporting economic and environmentally sustainable solutions.
- Continue to meet our corporate responsibility and accountability under the law for activities undertaken by the USACE, which may impact human and natural environments.
- Consider the environment in employing a risk management and systems approach throughout the life cycles of projects and programs.
- Leverage scientific, economic, and social knowledge to understand the environmental context and effects of USACE actions in a collaborative manner.

- Employ an open, transparent process that respects views of individuals and groups interested in USACE activities.

In coordination with the agencies and other stakeholders, the USACE proactively considered the environmental consequences of the proposed beneficial use of dredged material project. In accordance with the mandate of this designation and the EOPs, the USACE has proposed a project that supports economic and environmentally sustainable solutions.

6 PUBLIC INVOLVEMENT

Public involvement activities and agency coordination are summarized in this chapter.

6.1 PUBLIC VIEWS AND COMMENTS

The Draft IFR/EA will be released 29 March 2022 for public comment.

6.2 STAKEHOLDER AGENCY COORDINATION

Early coordination letters were sent to Federally Recognized Tribes on March 30, 2021 along with the U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, Michigan Department of Energy, Great Lakes, and the Environment (EGLE), and the Michigan Department of Natural Resources (MIDNR). . This letter included a brief description of the project authority, applicable regulations (including NEPA), the project area, environment, and history, formulated alternatives, and recognized Archeological Districts and Historic Places. The primary purpose of this letter was to inform agencies and Tribes on the initiation of the feasibility study and the selection of a TSP triggering a determination of the appropriate NEPA evaluation, and the start of said evaluation. Responses were received from the Saginaw-Chippewa Tribe of Michigan, Pokagon Band of Potawatomi, USEPA, Michigan DNR, and EGLE. All responses indicated the need for continued coordination as an alternative is selected and the project progresses into design.

Additionally, regulatory agencies indicated the need for sediment testing, to include physical and chemical parameters, of the Toledo Harbor Federal Navigation Project dredge material to be placed at Woodtick Peninsula. Michigan DNR specifically requested additional information regarding the geosynthetic containers used in artificial reef construction. EGLE provided a brief list of potential Statues under their authority by which the project would need to be permitted.

7 ENVIRONMENTAL COMPLIANCE

This chapter provides documentation on how the TSP/ recommended plan for the study comply with all applicable Federal environmental laws, statues, and executive orders.

7.1 REGULATORY FRAMEWORK

The Alternatives evaluated for restoration of Woodtick Peninsula located in Monroe County, Michigan have been reviewed pursuant to the following Acts and Executive Orders:

- Fish and Wildlife Act of 1956
- Fish and Wildlife Coordination Act of 1958
- National Historic Preservation Act of 1966
- National Environmental Policy Act of 1969
- Clean Air Act of 1970
- Executive Order 11593, Protection and Enhancement of the Cultural Environment, May 1971
- Coastal Zone Management Act of 1972
- Endangered Species Act of 1973
- Clean Water Act of 1977
- Coastal Barrier Resources Act (CBRA, Public Law 97-348) of 1982
- Executive Order 11988, Flood Plain Management, May 1977
- Executive Order 11990, Wetland Protection, May 1977
- Executive Orders 13112 & 13751, Invasive Species, February 1999 & December 2016
- Executive Order 13186, Responsibilities of Federal Agencies to Protect Migratory Birds, January 2001
- Executive Order 13352, Facilitation of Cooperative Conservation, August 2004

The Alternatives have been found to be in compliance with these Acts and Executive Orders. A CZMA federal determination will be submitted to the State of Michigan for the Tentatively Selected Alternative upon selection. A Clean Water Act Section 404(b)(1) evaluation of the environmental effects of the discharge of fill into waters of the U.S. has been prepared and found to be in compliance (Appendix I). A Section 401 Water Quality Certificate, or waiver thereof, will be obtained from the State prior to construction. A review of listed species has been completed, and findings have been documented in compliance with the Endangered Species Act.

7.2 ENVIRONMENTAL CONCLUSIONS

All applicable laws, executive orders, and regulations were considered in the evaluation and coordination with appropriate agencies has been identified or begun. The proposed Alternative

were reviewed with respect to the Regulatory Framework for the project (See Section 7.1), including the 17 Points of Environmental Quality (See Section 4.11). Implementing the recommended plan would not result in significant cumulative or long-term adverse environmental effects. The project would cause no or insignificant minor adverse impacts to cultural and natural resources, would not adversely impact navigation, water quality, federally listed threatened or endangered species and their habitat, nor be injurious to the public interest. A summary assessment of the potential effects of the proposed Alternative are listed in Table 16.

Direct and indirect impacts will, or are likely, to result from the proposed Alternatives. The direct impacts from the placement of dredge material (and construction of artificial reefs), and associated construction activity and traffic will produce short-term negative impacts to the environment of Woodtick Peninsula and associated resources. These impacts will be limited in space to the project area and surrounding aquatic habitat within a short distance of active placement locations. Impacts will be most pronounced during active construction and for approximately 3-5 years following completion as the ecosystem naturally recovers from the disturbance. No threatened or endangered species are likely to be adversely affected as they either do not occur within the project area or are capable of physically leaving the impacted area.

Indirect impacts from the Alternatives include the disruption to the environment, aesthetics, and recreation that will be similarly limited in time and duration as direct impacts. Following the completion of construction there will be minor, but observable, difference to the aesthetic and recreational elements of Woodtick Peninsula. The Alternatives are designed to provide a net benefit to the ecosystem and resilience of Woodtick Peninsula, so it is anticipated that the indirect impacts will be considered to amount to no difference or a net benefit over the lifespan of the project.

Review of the proposed Alternatives indicate that no significant adverse environmental impacts are likely to result from the proposed Alternatives. Implementation of any of the alternatives would not be expected to impact or alter the local or regional climate at or near Woodtick Peninsula, due to the relatively small scale of the project, and the measures being implemented. Federal and State listed species that may occur in the project area are likely rare, capable of moving away from the project area and construction activity, and not reliant on the project area for their continued survival.

The assessment of the environmental consequences of the Alternatives concludes that the proposed Alternatives:

a. Would have no significant cumulative or long-term adverse environmental impacts associated with project actions of the Alternative;
b. Is not likely to adversely affect any Federal or State listed species or critical or significant habitat;
c. Will produce benefits that outweigh the minor, temporary impacts that may result, and;

d. Does not constitute a major Federal action significantly affecting the quality of the human environment.

Table 18: Summary of the effects for the proposed Alternatives for Woodtick Peninsula.

	Insignificant effects	Insignificant effects as a result of mitigation*	Resource unaffected by action
Aesthetics	☒	☐	☐
Air quality	☒	☐	☐
Aquatic resources/wetlands	☒	☐	☐
Invasive species	☒	☐	☐
Fish and wildlife habitat	☒	☐	☐
Threatened/Endangered species/critical habitat	☒	☐	☐
Historic properties and Cultural Resources	☐	☒	☐
Floodplains	☐	☐	☒
Hazardous, toxic & radioactive waste	☐	☐	☒
Hydrology	☒	☐	☐
Land use	☐	☐	☒
Navigation	☒	☐	☐
Noise levels	☒	☐	☐
Public infrastructure	☐	☐	☒
Socio-economics	☐	☐	☒
Environmental justice	☐	☐	☒
Soils	☒	☐	☐
Tribal trust resources	☐	☐	☐
Water quality	☒	☐	☐
Climate change	☐	☐	☒

8 RECOMMENDATION

The following text outlines the USACE's recommendations for approval of the tentatively selected plan and authorization for implementation, under Section 204 of WRDA 1992 (P.L. 102-980).

To achieve the project objectives, I recommend implementation of Alternative 4A to beneficially use dredged material from Toledo Harbor, OH for ecosystem restoration purposes at Woodtick Peninsula located in Monroe County, MI. Alternative 4A consists of in-water placement of approximately 156,000 cubic yards of Toledo Harbor dredged material for the purpose of aquatic habitat creation. In addition, geosynthetic containers, filled with dredged material and topped with stone, will be placed at the southern end of Woodtick Peninsula to create an offshore reef to further improve habitat.

Alternative 4A is the NER Plan. The construction cost (project first cost) for Alternative 4A is $5,529,000 (FY22). Implementation would be cost-shared at a federal contribution of $3,593,850 and non-federal sponsor contribution of $1,935,150.

The non-federal sponsor, the Michigan Department of Natural Resources, supports this plan and there is no Locally Preferred Plan. It is anticipated that the Michigan Department of Natural Resources will be the non-federal sponsor for the Preconstruction, Engineering, and Design phase, and for the Construction phase of the project.

The recommendation contained herein reflects the information available at this time and current departmental policies governing formulation of individual projects. It does not reflect program and budgeting priorities inherent in the formulation of a national civil works construction program or the perspective of higher review levels within the executive branch.

Scott M. Katalenich
Lieutenant Colonel, U.S. Army
District Engineer

9 REFERENCES

Allinger, L.E., Reavie, E.D. 2013. The ecological history of Lake Erie as recorded by the phytoplankton community. Journal of Great Lakes Research 39(3): 365-382. https://doi.org/10.1016/j.jglr.2013.06.014

Ahlstedt, S.A. 2009. Federal Fish and Wildlife Permit Annual Report (12-15-09), Endangered Species Permit Number: TE113009-0, Catspaw *Epioblasma obliquata obliquata*, White Catspaw *Epioblasma obliquata perobliqua*. P.O. Box 460, 57 Deer Ridge Rd., Norris, TN 37828. 6pp.

Ahlstedt, S.A. 2010. Federal Fish and Wildlife Permit Annual Report (2010), Endangered Species Permit Number: TE113009-0, Catspaw *Epioblasma obliquata obliquata*, White Catspaw *Epioblasma obliquata perobliqua*. P.O. Box 460, 57 Deer Ridge Rd., Norris, TN 37828. 6pp.

Ahlstedt, S.A. 2011. Federal Fish and Wildlife Permit Annual Report (11-18-11), Endangered Species Permit Number: TE113009-1, OH Wild Animal Permit: 12-01, IN License Number: 11-0001, Catspaw *Epioblasma obliquata obliquata*, White Catspaw *Epioblasma obliquata perobliqua*. P.O. Box 460, 57 Deer Ridge Rd., Norris, TN 37828. 7pp.

Badra, P.J. 2009. Status of Native Freshwater Mussels, Including the Northern Riffleshell (*Epioblasma torulosa rangiana*) and Rayed Bean (*Villosa fabalis*), in Detroit River, Michigan. Report number MNFI 2009-5. Report to U.S. Fish and Wildlife Service, Ft. Snelling, MN. 15pp.

Berkman, P.A., Haltuch, M.A., Tichich, E., Garton, D.W., Kennedy, G.W., Gannon, J.E., Mackey, S.C., Fuller, J.A., and Liebenthal, D.L. 1998. Zebra mussels invade Lake Erie muds. Nature 393: 27-28. https://doi.org/10.1038/29902.

Binford, Lewis R. 1980. Willow Smoke and Dogs' Tails: Hunter-Gatherer Settlement Systems and Archeological Site Formation. American Antiquity 45: 4-20.

Boedecker, A.R., Niewinski, D.N., Newell, S.E., Chaffin, J.D., and McCarthy, M.J. 2020. Evaluating sediments as an ecosystem service in western Lake Erie via quantification of nutrient cycling pathways and selected gene abundances. J. Great Lakes Res. 46(4): 920-932. https://doi.org/10.1016/j.jglr.2020.04.010.

Bowles, M.L. 1983. The tallgrass prairie orchids *Platanthera leucophaea* (Nutt.) Lindl. And *Cypripedium candidum* Muhl. ex Wild.: some aspects of their status, biology, and ecology and implications toward management. Natural Areas Journal 3(4):14-37.

Burch, J.B. 1994 Mollusk: Species Accounts. In: Evers, D.C. *ed*. Endangered and Threatened Wildlife of Michigan. University of Michigan Press, Ann Arbor. pp. 395-410.

Bureau of Transportation Statistics. 2018. National Transportation Noise Map [web application]. U.S. Department of Transportation. https://data.bts.gov/stories/s/National-Transportation-Noise-Map/ri89-bhxh/ Accessed 19 January 2022.

Calderon, M.R., Almedia, C.A., González, P., and Jofré, M.B. 2019. Influence of water quality and habitat conditions on amphibian community metrics in rivers affected by human activity. Urban Ecosystems 22: 743-755. https://doi.org/10.1007/s11252-019-00862-w.

Chaffin, J.D., Bridgeman, T.B., Bade, D.L, and Mobilian, C.N. 2014. Summer phytoplankton nutrient limitation in Maumee Bay of Lake Erie during high-flow and low-flow years. J. Great Lakes Res. 40(3): 524-531. https://doi.org/10.1016/j.jglr.2014.04.009.

Cohen, J.G., Kost, M.A., Slaughter, B.S., Albert, D.A., Lincoln, J.M., Kortenhoven, A.P., Wilton, C.M., Enander, H.D., and Korroch, K.M. 2020. Michigan Natural Community Classification [web application]. Michigan Natural Features Inventory, Michigan State University Extension, Lansing, Michigan. Available https://mnfi.anr.msu.edu/communities/classification. Accessed 4.January.2022).

Cooper M.J. and Uzarski D.G. 2016. Invertebrates in Great Lakes Marshes. In: Batzer D. and Boix D. (eds) Invertebrates in Freshwater Wetlands. Springer, Cham. https://doi.org/10.1007/978-3-319-24978-0_9.

Croft, M.V. and Chow-Fraser, P. 2007. Use and development of the Wetland Macrophyte Index to detect water quality impairment in fish habitat of Great Lakes coastal marshes. J. Great Lakes Res. 33(Special Issue 3): 172-197.

Crosson, A.E., Dunford, J.C., and Young, D.K. 1999. Pollination and other insect interactions of the Eastern Prairie Fringed Orchid (*Platanthera leucophaea* (Nuttall) Lindl.) in Wisconsin. Report to the U.S. Fish and Wildlife Service.

Cummins, G., Carner, M., and May, C.. 2017. Erie Marsh Preserve Draft Environmental Assessment: Erie Marsh Preserve Coastal Wetland Restoration Project. Prepared for The Nature Conservancy. https://www.fws.gov/midwest/news/documents/MI_Erie_Marsh_EA.pdf Accessed 4.January.2022.

Cuthbert, F. J. and Roche, E. A. 2006. Piping plover breeding biology and management in the Great Lakes. Unpublished report submitted to the U.S. Fish and Wildlife Service, East Lansing, Michigan.

Cuthbert, F. J. and Roche, E. A. 2007. Estimation and evaluation of demographic parameters for recovery of the endangered Great Lakes Piping Plover population. Unpublished report submitted to the U.S. Fish and Wildlife Service, East Lansing, Michigan.

Cuthrell, D.L., Higman, P.J., and Penskar, M.R. 1999. The pollinators of Ohio and Michigan populations of Eastern Prairie Fringed orchid (*Platanthera leucophaea*). Michigan Natural Features Inventory, Lansing, Michigan. 20 pp.

Daloglu, I., Cho, K.H., and Scavia, D. 2012. Evaluating causes of trends in long-term dissolved reactive phosphorus loads to Lake Erie. Environ. Sci. Technol., 46: 10660-10666.

Depew, D.C., Houben, A.J., Ozersky, T., Hecky, R.E., and Guildford, S.J. 2011. Submerged aquatic vegetation in Cook's Bay Lake Simcoe: Assessment of changes in response to increased water transparency. J. Great Lakes Res. 37(3): 72-82. https://doi.org/10.1016/j.jglr.2010.07.009.

Dragoo, Donald W. 1976, Some Aspects of Eastern North American Prehistory: A Review. American Antiquity 41: 3-27.

E&E/LimnoTech .2014. Influence of Open-Lake Placement of Dredged Material on Western Lake Erie Basin Harmful Algal Blooms – Final Study Report. Technical report prepared for USACE, Buffalo District.

Environment and Climate Change Canada and the U.S. Environmental Protection Agency. 2021. Lake Erie Lakewide Action and Management Plan, 2019-2023. Available online at https://binational.net/wp-content/uploads/2021/11/EN-2019-2023-Lake-Erie-LAMP.pdf Accessed 04.February.2022.

Environment Canada. 2012. Recovery Strategy for the Eastern Prairie Fringed-orchid (*Platanthera leucophaea*) in Canada. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa.

Environmental Protection Agency. 2018. Interactive Map of Air Quality [web application]. AirNow. https://gispub.epa.gov/airnow/index.html?tab=3 Accessed 19 January 2022.

EnviroScience, Inc. 2012. Quantitative Freshwater Mussel Surveys in Four Locations on Fish Creek and the St. Joseph River in Williams County, Ohio, September, 2012. ES Project #5473. Report prepared for: The Nature Conservancy, Indiana Field Office, Indianapolis, IN, and Indiana Department of Natural Resources, Indianapolis, IN. 9pp.

Fall, K.A., Perkey, D.W., Tyler, Z.J., and Welp, T.W. 2021. Field measurement and monitoring of hydrodynamic and suspended sediment within the Seven Mile Island Innovation Laboratory, New Jersey. Technical Note (Engineer Research and Development Center (U.S.)). ERDC/CHL TR-21-9. http://dx.doi.org/10.21079/11681/40980.

Goldsmith, A.M., Jaber, F.H., Ahmari, H., and Randklev, C.R. 2021. Clearing up cloudy waters: a review of sediment impacts to unionid freshwater mussels. Environmental Reviews 29(1) https://doi.org/10.1139/er-2020-0080.

Grand, J., Saunders, S.P., Michel, N.L., Elliott, L., Beilke, S., Bracey, A., Gehring, T.M., Gnass Giese, E.E., Howe, R.W., Kasberg, B., Miller, N., Niemi, G.J., Norment, C.J., Tozer, D.C., Wu, J., and Wilsey, C. 2020. Prioritizing coastal wetlands for marsh bird conservation in the U.S. Great Lakes. Biological Conservation 249: 108708. https://doi.org/10.1016/j.biocon.2020.108708.

Guy, D.E., Jr., and Rockaway, J.D., 2004. Geologic setting and coastal processes along the western shore of Lake Erie and Kelleys Island, Ohio. In: Proceeding Annual Meeting of the Association of Engineering Geologists (Sandusky, Ohio: Ohio Department of Natural Resources, Office of Lake Survey), 38p.

Federal Emergency Management Agency. 2020. Flood Insurance Study Monroe County, Michigan (All Jurisdictions). FEMA Flood Map Service Center. https://map1.msc.fema.gov/data/26/S/PDF/26115CV001B.pdf?LOC=463d3b8eb68e8fa5b721af9e7ad51156. Accessed 28 January 2022.

Francis, J., and Boase, J. 2007. A fisheries survey of selected Lake Erie coastal marshes in Michigan, 2005. Michigan Department of Natural Resources & U.S. Fish and Wildlife Service. 28pp.

Haack, S.K., Neff, B.P., Rosenberry, D.O., Savino, J.F., and Lundstrom, S.C. 2005. An evaluation of effects of groundwater exchange on nearshore habitat and water quality of western Lake Erie. Journal of Great Lakes Research 31(Supp. 1): 45-63. https://doi.org/10.1016/S0380-1330(05)70289-6.

Hecnar, S.J. 2004. Great Lakes wetlands as amphibian habitats: A review. Aquatic Ecosystem Health & Management. 7(2): 289-303. https://doi.org/10.1080/14634980490461542.

Henley, W.F., Patterson, M.A., Neves, R.J., and Lemly, A.D. 2000. Effects of sedimentation and turbidity on lotic food webs: A concise review for natural resource managers. Reviews in Fisheries Science 8(2): 125-139. https://doi.org/10.1080/10641260091129198.

Herdendorf, C. E. 1987. The ecology of the coastal marshes of western Lake Erie: a community profile. U.S. Fish and Wildlife Service, Biological Report 85(7.9).

Herdendorf, C.E. 1992. Lake Erie coastal wetlands: An overview. J. Great Lakes Res. 18(4): 533-551. https://doi.org/10.1016/S0380-1330(92)71321-5.

Hunt, S.D., Guzy, J.C., Price, S.J., Halstead, B.J., Eskew, E.A., and Dorcas, M.E. 2013. Response of riparian reptile communities to damming and urbanization. Biological Conservation 157: 277-284. https://doi.org/10.1016/j.biocon.2012.08.035.

Hygnstrom, S.E., Timm, R.M., Curtis, P.D., Nolte, D.L., Tobin, M.E., and VerCauteren, K.C. 2014. Prevention and Control of Wildlife Damage, 5th Edition. USDA National Wildlife Research Center - Staff Publications. 1782. https://digitalcommons.unl.edu/icwdm_usdanwrc/1782

International Joint Commission (IJC) 2013. Lake Erie Ecosystem Priority: Scientific Findings and Policy Recommendations to Reduce Nutrient Loadings and Harmful Algal Blooms Draft summary report. Windsor, ON.

Jude, D. J. and Pappas, J. 1992. Fish utilization of Great Lakes coastal wetlands. Journal of Great Lakes Research 18: 651-672.

Kim, D-K, Javed, A., Yang, C., and Arhonditsis, G.B. 2018. Development of a mechanistic eutrophication model for wetland management: Sensitivity analysis of the interplay among phytoplankton, macrophytes, and sediment nutrient release. Ecological Informatics 48: 198-214. https://doi.org/10.1016/j.ecoinf.2018.09.010.

Kjelland, M.E., Woodley, C.M., Swannack, T.M., and Smith, D.L. 2015. A review of the potential effects of suspended sediment on fishes: potential dredging-related physiological, biological, and transgenerational implications. Environ. Syst. Decis. 35: 334-350. DOI 10.1007/s10669-015-9557-2.

Kost, M.A., Albert, D.A., Cohen, J.G., Slaughter, B.S., Schillo, R.K., Weber, C.R., and Chapman, K.A. 2007. Natural Communities of Michigan: Classification and Description. Michigan Natural Features Inventory, Report No. 2007-21, Lansing, MI.

Leach, J.H. 1993. Impacts of the zebra mussel (Dreissena polymorpha) on water quality and fish spawning reefs in western Lake Erie. In: Nalepa, T.F., and Schloesser, D.W. (Eds.), Zebra mussels, Biology, Impacts, and Control, Lewis Publ., Boca Raton, Florida (1993), pp. 381-397.

Lick, W. and Kang, S.W. 1987. Entrainment of sediments and dredged materials in shallow lake waters. J Great Lakes Res 13:619-627.

Manny, B.A., Roseman, E.F., Kennedy, G., Boase, J.C., Craig, J.M., Bennion, D.H., Read, J., Vaccaro, L., Chiotti, J., Drouin, R., and Ellison, R. 2015. A scientific basis for restoring fish spawning habitat in the St. Clair and Detroit Rivers of the Laurentian Great Lakes. Restoration Ecology 23(2): 149-156. https://doi.org/10.1111/rec.12159.

McLean, M., Roseman, E.F., Pritt, J.J., Kennedy, G., and Manny, B.A. 2015. Artificial reefs and reef restoration in the Laurentian Great Lakes. J. Great Lakes Res. 41(1): 1-8. https://doi.org/10.1016/j.jglr.2014.11.021.

Meyer, K.A., Davis, T.W., Watson, S.B., Denef, V.J., Berry, M.A., and Dick, G.J. 2017. Genome sequences of lower Great Lakes *Microcystis sp.* reveal strain-specific genes that are present and expressed in western Lake Erie blooms. PLoS One https://doi.org/10.1371/journal.pone.0183859.

Michigan Department of Natural Resources. 2009. Michigan Karner blue butterfly habitat conservation plan. Wildlife Division Report No. 3514. https://ecos.fws.gov/docs/plan_documents/thcp/thcp_945.pdf Accessed 31.Jan.2022.

Michigan Department of Natural Resources. 2015. Wildlife Action Plan 2015-2025: Appendix 1 – Species of Greatest Conservation Need. https://www.michigan.gov/documents/dnr/wap_appendix1_ada_554231_7.pdf Accessed 24.Jan.2022.

Miller, J.W., Kocovsky, P.M., Weigmann, D., and Miner, J.G. 2018. Fish community response to submerged aquatic vegetation in Maumee Bay, Western Lake Erie. North American Journal of Fisheries Management 38(3): 623-629. https://doi.org/10.1002/nafm.10061.

Morang, A., Mohr, M.C., and Forgette, C.M. 2011. Longshore sediment movement and supply along the U.S. Shorline of Lake Erie. Journal of Coastal Research 27 (4): 619-635. DOI: 10.2112/JCOASTRES-D-09-00145.1.

Mozola, A.J. 1970. Geology for environmental planning in Monroe County, Michigan. Michigan Geological Survey Division Report of Investigation 13.

Natural Resources Council. 7.0 Construction noise impact assessment. Biological assessment preparation: Advanced training manual Version 02-2012. Available online at https://www.nrc.gov/docs/ML1225/ML12250A723.pdf Accessed 03.February.2022.

Neves, R.J. 1991. Mollusks. in: K. Terwilliger, coordinator. Virginia's endangered species. Proceedings of a symposium, April 1989, Blacksburg, Virginia. McDonald & Woodward Publishing Co., Blacksburg. pp. 251-319.

Newton, T.J. 2003. The effects of ammonia on freshwater unionid mussels. Environmental Toxicology and Chemistry 22(11):2543-2544.

Nicholas, J.R., Rowe, G.L., and Brannen, J.R. 1996. Hydrology, water quality, and effects of drought in Monroe County, Michigan. U.S. Geological Survey, Water-Resources Investigations Report 94-4161.

Ohio Department of Natural Resources. 2018. Ohio Coastal Atlas, 3rd Edition. Columbus, Ohio: Office of Coastal Management, Ohio Department of Natural Resources. https://ohiodnr.gov/wps/portal/gov/odnr/discover-and-learn/safety-conservation/about-odnr/coastal-management/ohio-coastal-mgmt-program/ohio-coastal-atlas-documents (accessed 03.January.2022).

Ohio Environmental Protection Agency. 2010. Methods of assessing habitat in Lake Erie shoreline waters using the Qualitative Habitat Evaluation Index (QHEI) Approach (Version 2.1). Available online at https://epa.ohio.gov/static/Portals/35/documents/QHEIManual_LakeErieShoreline_June2010.pdf Accessed 04.February.2022.

Ouyang, D., Bartholic, J., and Selegean, J. 2015 Assessing sediment loading from agricultural croplands in the Great Lakes Basin. J. Am. Sci., 1: 14-21.

Parmalee, P.W., and A.E. Bogan. 1998. The freshwater mussels of Tennessee. The University of Tennessee Press, Knoxville. 328 pp.

Paul, J.F., Kasprzyk, R., and Lick, W. 1982. Turbidity in the Western Basin of Lake Erie. J Geophys Res 87:5779-5784.

Peacock, E., W.R. Haag, and M.L. Warren, Jr. 2005. Prehistoric decline in freshwater mussel coincident with the advent of maize agriculture. Conservation Biology 19:547-551.

Pratt, G.M. 1980. North Maumee Bay Archeological District. National Register of Historic Places.

Pruitt, L., and TeWinkel, L. Eds. 2007. Indiana bat (*Myotis sodalist*) Draft Recovery Plan: First Revision. Department of the Interior, U.S. Fish and Wildlife Service, Region 3. https://ecos.fws.gov/docs/recovery_plan/070416.pdf Accessed 21.Jan.22.

Ray, G.L. 2007. Thin layer placement of dredged material on Coastal Wetlands: A review of the technical and scientific literature. Technical Note (Engineer Research and Development Center (U.S.)). ERDC/EL TN-07-1. https://apps.dtic.mil/sti/pdfs/ADA475811.pdf.

Reavie, E.D., Barbiero, R.P., Allinger, L.E. and Warren, G.J. 2014. Phytoplankton trends in the Great Lakes, 2001-2011. J. Great Lakes Res. 40(3): 618-639. https://doi.org/10.1016/j.jglr.2014.04.013.

Reimold, R.J., Hardisky, M.A., and Adams, P.C. 1978. The effects of smothering a Spartina alterniflora salt marsh with dredged material. Technical Report D-78-38. Report prepared for U.S. Army Engineer Waterways Experiment Station under Dredged Material Research Program. file:///C:/Users/H7EPEKAM/Documents/References/Reports%20&%20Whitepapers/Reimold%20et%20al.,%201978%20DMRP%20D-78-38.pdf. Accessed 24.September.2021.

Riccardi, A., Whoriskey, F.G., Rasmussen, J.B. 1997. The role of the zebra mussel (*Dreissena polymorpha*) in structuring macroinvertebrate communities on hard substrata. Can. J. Fish. Aquat. Sci. 54: 2596-2608. https://doi.org/10.1139/f97-174.

Richards, R., Baker, D., Crumrine, J. and Stearns, A. 2010. Unusually large loads in 2007 from the Maumee and Sandusky Rivers, tributaries to Lake Erie. J. Soil Water Conserv. 65: 450-462.

Robichaud, C.D. and Rooney, R.C. 2017. Long-term effects of *Phragmites australis* invasion on birds in a Lake Erie coastal marsh. J. Great Lakes Res. 43(3): 141-149. https://doi.org/10.1016/j.jglr.2017.03.018.

Robichaud, C.D., Basso, J.V., and Rooney, R.C. 2021. Control of invasive *Phragmites australis* (European common reed) alters macroinvertebrate communities. Restoration Ecology. e13548. https://doi.org/10.1111/rec.13548.

Roseman, E.F., Taylor, W.W., Hayes, D.B., Tyson, J.T., and Haas, R.C. 2005. Spatial patterns emphasize the importance of coastal zones as nursery areas for larval walleye in western Lake Erie. J. Great Lakes Res. 31(Suppl. 1): 28-44. https://doi.org/10.1016/S0380-1330(05)70288-4.

Saunders, S., Arnold, T., Roche, E., and Cuthbert, F. 2014 Age-specific survival and recruitment of Piping Plovers in the Great Lakes region. Journal of Avian Biology. 45:001-013.

Sekaluvu, L., Zhang, L., and Gitau, M. 2018. Evaluation of constraints to water quality improvements in the Western Lake Erie Basin. Journal of Environmental Management 205: 85-98. https://doi.org/10.1016/j.jenvman.2017.09.063.

Shane, K.D., Oubre, M.J., Crail, T.D., Miner, J.G., Mayer, C.M., Sasak, T.E., DeBruyne, R.L., Miller, J.J., Roseman, E.F., and Hintz, W.D. 2021. Towards improving an Area of Concern: Main-channel habitat rehabilitation priorities for the Maumee River. J. Great Lakes Res. 47(5): 1429-1436. https://doi.org/10.1016/j.jglr.2021.08.001.

Sierszen, M.E., Morrice, J.A., Trebitz, A.S., and Hoffman, J.C. 2012. A review of selected ecosystem services provided by coastal wetlands of the Laurentian Great Lakes. Aquatic Ecosystem Health & Management 15(1): 92-106. https://doi.org/10.1080/14634988.2011.624970.

Smith, D.R., King, K.W., and Williams M.R. 2015 What is causing the harmful algal blooms in Lake Erie? J. Soil Water Conserv. 70: 27A-29A.

Sorg, S. 2017. Species spotlight: the rufa red knot. Michigan Nature Association. https://michigannature.org/news/article/Species-Spotlight-the-rufa-red-knot.html#:~:text=Rufa%20red%20knot%20(Calidris%20canutus,the%20eastern%20North%20American%20species. Accessed 24.Jan.2022.

Soster, F.M., McCall, P.L., and Herrmann, K.A. 2011. Decadal changes in the benthic invertebrate community in western Lake Erie between 1981 and 2004. J. Great Lakes Res. 37(2): 226-237. https://doi.org/10.1016/j.jglr.2011.03.005.

Spear, S. 2014. Toledo water Ban Lifted, but Is the Water Safe and what Caused the Toxic Algae Bloom? EcoWatch, August 05, 2014. Available at: http://www.ecowatch.com/toledo-water-ban-lifted-but-is-the-water-safe-and-what-caused-the-toxi-1881940622.html. Accessed 03.January.2022.

Steen, D.A., Gibbs, J.P., and Timmermans, S.T.A. 2006. Assessing the sensitivity of wetland bird communities to hydrologic change in the Eastern Great Lakes region. Wetlands 26(2): 605-611. https://doi.org/10.1672/0277-5212(2006)26[605:ATSOWB]2.0.CO;2.

Stothers, D.M. and G.M. Pratt. 1980. The Culture History of the Southwestern Lake Erie Drainage Basin. Paper presented at 7th Annual Archeological Symposium of the Ontario Archeological Society.
Stoutamire, W.P. 1974. Terrestrial orchid seedlings. In: C.C. Withner, editor. The orchids: Scientific studies. John Wiley and Sons, New York, New York. p 101-128.

Stow, C.A., Cha, Y., Johnson, L.T., Confesor, R., and Richards, R.P. 2015 Long-term and seasonal trend decomposition of Maumee River nutrient inputs to western Lake Erie. Environ. Sci. Technol., 49: 3392-3400.

Stricker, M. and K. Fredrick. 2018. Phase I Archeological Survey of Proposed Natural Gas Lines at Historic Fort Wayne (20WN2105), Detroit, Michigan. Report completed for the National Park Service.

Stucker, J. H., Cuthbert, F. J., and C.D. Haffner. 2003. Piping plover breeding biology and management in the Great Lakes. Unpublished report submitted to the U.S. Fish and Wildlife Service, East Lansing, Michigan.

Stucker, J. H., and F.J. Cuthbert. 2004. Piping plover breeding biology and management in the Great Lakes. Unpublished report submitted to the U.S. Fish and Wildlife Service, East Lansing, Michigan.

Sturtevant, R., Lower, E., Bartos, A., and Elgin, A. 2021. A review and secondary analysis of competition-related impacts of nonindigenous aquatic plants in the Laurentian Great Lakes. Plants. 10(2). https://doi.org/10.3390/plants10020406

Suedel, B.C., Lutz, C.H., Clarke, J.U., and Clarke, D.G. 2012. The effects of suspended sediment on walleye (*Sander vitreus*) eggs. J. Soils Sediments 12:995-1003. DOI 10.1007/s11368-012-0521-1.

Suedel, B.C., Clarke, J.U., Lutz, C.H., Clarke, D.G., Godard-Codding, C., and Maul, J. 2014. Suspended sediment effects on walleye (*Sander vitreus*). J. Great Lakes Res. 40(1): 141-148. https://doi.org/10.1016/j.jglr.2013.12.008.

Sullivan, T.J. and Stepien, C.A. 2014. Genetic diversity and divergence of yellow perch spawning populations across the Huron-Erie Corridor, from Lake Huron through western Lake Erie. J. Great Lakes Res. 40(Supp. 2): 101-109. https://doi.org/10.1016/j.jglr.2012.12.004

Summers, R.B., Thorp, J.H., Alexander, J.E. Jr., and Fell, R.D. 1996. Respiratory adjustment of dreissenid mussels (*Dreissena polymorpha* and *Dreissena bugensis*) in response to chronic turbidity. Can. J. Fish. Aquat. Sci. 53: 1626-1631. Available online at: https://cdnsciencepub.com/doi/pdf/10.1139/f96-096 Accessed 02.February.2022.

Sweeney, R.A. 1978. Aquatic Disposal Field Investigations, Ashtabula River Disposal Site, Ohio – Evaluative Summary. Technical Report D-77-42. Report prepared for U.S. Army Engineer Waterways Experiment Station under Dredged Material Research Program.

The Nature Conservancy. 2012. Returning to a Healthy Lake: An International Biodiversity Conservation Strategy for Lake Erie. https://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/michigan/Documents/LEBCS%20Report.pdf Accessed 03.September.2021.

Thorp, J.H., Alexander, J.E. Jr., Bukaveckas, B.L., Cobbs, G.A., and Bresko, K.L. 1998. Can. J. Fish. Aquat. Sci. 55(1) https://doi.org/10.1139/f97-242.

Tozer, D.C. 2016. Marsh bird occupancy dynamics, trends, and conservation in the southern Great Lakes basin: 1996 to 2013. J. Great Lakes Res. 42(1): 136-145. https://doi.org/10.1016/j.jglr.2015.10.015.

U.S. Army Corps of Engineers, Buffalo District, April 2009. Finding of No Significant Impact and Environmental Assessment. Operations and Maintenance Dredging and Placement of Dredged Material. Toledo Harbor. Lucus County, Ohio.

U.S. Environmental Protection Agency and U.S. Army Corps of Engineers. 1998. Great Lakes Dredged Material Testing and Evaluation Manual. http://www.epa.gov/glnpo/sediment/gltem/manual.htm.

U.S. Environmental Protection Agency. 2020. Section 404 of the Clean Water Act, CWA Section 404(b)(1) Guidelines (40 CFR 230). https://www.epa.gov/cwa-404/cwa-section-404b1-guidelines-40-cfr-230.

U.S. Department of the Interior, Fish and Wildlife Service. 2001. Endangered and threatened wildlife and plants; Final Determination of critical habitat for the Great Lakes breeding population of the Piping Plover. Final Rule. Federal Register. May 7: 66(88): 22938-22969.

U.S. Department of the Interior, Fish and Wildlife Service. 2016. Endangered and threatened wildlife and plants; Threatened species status for the Eastern Massasauga rattlesnake. Final Rule. Federal Register. September 30: 81(190): 67193-67214.

U.S. Department of the Interior, Fish and Wildlife Service. 2021. Endangered and threatened wildlife and plants; designation of critical habitat for the Rufa Red Knot (*Calidris canutus rufa*). Proposed Rule. Federal Register. July 15: 86(133): 37410-37668.

U.S. Fish and Wildlife Service. 1986. North American Waterfowl Management Plan: A Strategy for Cooperation. https://www.fws.gov/migratorybirds/pdf/management/NAWMP/OriginalNAWMP.pdf 26pp.

U.S. Fish and Wildlife Service. 1999. Eastern Prairie Fringed Orchid (*Platanthera leucophaea*) Recovery Plan. Fort Snelling, Minnesota.

U.S. Fish and Wildlife Service. 2002. Status assessment report for the rayed bean, *Villosa fabalis*, occurring in the Mississippi River and Great Lakes systems (U.S. Wildlife Service Regions 3, 4, and 5, and Canada). Asheville, North Carolina.

U.S. Fish and Wildlife Service. 2003. Final recovery plan for the Karner blue butterfly (*Lycaeides melissa samuelis*). Fort Snelling, Minnesota.

U.S. Fish and Wildlife Service. 2007. National Bald Eagle Management Guidelines. May 2007. Available online at https://www.fws.gov/northeast/ecologicalservices/pdf/NationalBaldEagleManagementGuidelines.pdf. Accessed 04.February.2022.

U.S. Fish and Wildlife Service. 2009. Piping Plover (*Charadrius melodus*). 5-Year Review: Summary and Evaluation. Hadley, Massachusetts and East Lansing, Michigan.

U.S. Fish and Wildlife Service. 2019. Karner Blue Butterfly (*Lycaeides melissa samuelis*). 5-Year Review: Summary and Evaluation. Bloomington, Wisconsin. https://ecos.fws.gov/docs/tess/species_nonpublish/2929.pdf Accessed 31.Jan.2022.

U.S. Fish and Wildlife Service. 2019. Northern Riffleshell (*Epioblasma torulosa rangiana*). 5-Year Review: Summary and Evaluation. State College, Pennsylvania. https://ecos.fws.gov/docs/tess/species_nonpublish/2773.pdf Accessed 25.Jan.2022.

U.S. Fish and Wildlife Service. 2020. 5-year review: Eastern prairie fringed orchid (*Platanthera leucophaea*). Chicago, Illinois and Bloomington, Massachusette. 54 FR 39857-39863. https://ecos.fws.gov/docs/tess/species_nonpublish/3211.pdf Accessed 01.February.2022.

U.S. Fish and Wildlife Service. 2020. Piping Plover (*Charadrius melodus*). 5-Year Review: Summary and Evaluation. East Lansing, Michigan and Hadley, Massachusetts. https://ecos.fws.gov/docs/tess/species_nonpublish/2951.pdf Accessed 24.Jan.2022.

U.S. Fish and Wildlife Service. 2012. North American Waterfowl Management Plan 2012: People Conserving Waterfowl and Wetlands. https://www.fws.gov/migratorybirds/pdf/management/NAWMP/2012NAWMP.pdf 70pp.

Wang, S., Jurik, T.W., and van der Valk, A.G. 1994. Effects of sediment load on various stages in the life and death of cattail (Typha × Glauca). Wetlands 14(3): 166-173. https://link.springer.com/content/pdf/10.1007/BF03160653.pdf. Accessed 24.September.2021.

Watson, S.B., Miller, C., Arhonditsis, G., Boyer, G.L., Carmichael, W., Charlton, M.N.R., Confesor, R., Depew, D.C., Höök, T.O., and Ludsin, S.A. 2016. The re-eutrophication of Lake Erie: harmful algal blooms and hypoxia. Harmful Algae, 56 : 44-66. 10.1016/j.hal.2016.04.010.

Wei, A., Chow-Fraser, P., and Albert, D. 2004. Influence of shoreline features on fish distribution in the Laurentian Great Lakes. Canadian Journal of Fisheries and Aquatic Sciences 61: 1113-1123.

Weiten, A.C., Cooper, M.J., Parker, A.D., and Uzarski, D.G. 2012. Great Lakes coastal wetland habitat use by seven turtle species: influences of wetland type, vegetation, and abiotic conditions. Wetlands Ecol. Manage. 24: 47-58. DOI 10.1007/s11273-011-9240-4.

West, E.L., Metcalfe-Smith,, J.L., and Staton, S.K. 2000. Status of the rayed bean, *Villosa fabalis* (Bivalvia: Unionidae), in Ontario and Canada. Canadian Field-Naturalist 114:248-258.

Westbrock, M., Roche, E.A., Cuthbert, F.J. and Stucker, J.H. 2005. Piping plover breeding biology and management in the Great Lakes, 2005. Report submitted to the US Fish and Wildlife Service, East Lansing, MI.

Western Hemisphere Shorebird Reserve Network. Lake Erie Marsh Region. https://whsrn.org/whsrn_sites/lake-erie-marsh-region/ Accessed 03.September.2021.

Wilson, K.A., Howell, E.T., and Jackson, D.A. 2006. Replacement of zebra mussels by quagga mussels in the Canadian nearshore of Lake Ontario: the importance of substrate, round goby abundance, and upwelling frequency. J. Great Lakes Res. 32: 11-28. https://doi.org/10.3394/0380-1330(2006)32[11:ROZMBQ]2.0.CO;2.

Woolnough, D.A. 2002. Life history of endangered freshwater mussels of the Sydenham River, southwestern Ontario, Canada. Unpublished master's thesis, University of Guelph, Guelph, Ontario.

Zhu, B., Fitzgerald, D.G., Hoskins, S.B., Rudstam, L.G., Mayer, C.M., and Mills, E.L. 2007. Quantification of historical changes of submerged aquatic vegetation cover in two bays of Lake Ontario with three complimentary methods. J. Great Lakes Res. 33(1): 122-135. https://doi.org/10.3394/0380-1330(2007)33[122:QOHCOS]2.0.CO;2.