

# Old Woman Creek National Estuarine Research Reserve Management Plan 2011-2016



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*This management plan has been developed in accordance with NOAA regulations, including all provisions for public involvement. It is consistent with the congressional intent of Section 315 of the Coastal Zone Management Act of 1972, as amended, and the provisions of the Ohio Coastal Management Program.*

## **Acknowledgements**

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Photos provided by Tim Baldwin, Heather Elmer, Linda Feix, Melissa Myers, Phoebe Van Zoest, and Gene Wright.

### **Dedication**

This edition of the management plan is dedicated to all of those individuals who have contributed to the successes of the Old Woman Creek NERR throughout its existence:

- Past and present members of the OWC NERR staff and OWC NERR Advisory Council
- OWC NERR volunteer staff
- Members of the Friends of Old Woman Creek
- The Ohio Department of Natural Resources
- The ODNR Divisions of Wildlife and Natural Areas
- Our program partners

This management plan is also dedicated to our many visitors and program participants who have learned about estuaries at the Old Woman Creek NERR and then acted to protect them in the Great Lakes and around the country. You have made all our efforts worthwhile.

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## Abbreviations and Acronyms Used in This Document

ACI	Area of Conservation Interest
ADA	Americans with Disabilities Act of 1990
CDMO	Centralized Data Management Office
CELCP	Coastal and Estuarine Land Conservation Program
CFR	Code of Federal Regulations
CLEAR	Center for Lake Erie Area Research
CSC	Coastal Services Center, NOAA
CSO	Coastal States Organization
CTP	Coastal Training Program
CZM	Coastal Zone Management
CZMA	Coastal Zone Management Act of 1972
DL	Distance Learning
DNAP	Division of Natural Areas and Preserves
EHOVE	Erie-Huron-Ottawa Vocational Education
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ERD	Estuarine Reserves Division, OCRM
FCTW	Firelands Coastal Tributaries Watershed Program
FY	Ohio Fiscal Year (July – June)
FFY	Federal Fiscal Year (October – September)
FTE	Full time equivalent
GIS	Geographic Information System
GLERL	Great Lakes Environmental Research Laboratory
GLOS	Great Lakes Observing System
GPS	Global Positioning System
GRF	Graduate Research Fellowship
HVAC	Heating, ventilation, and air conditioning
IAGLR	International Association for Great Lakes Research
KEEP	K-12 Estuarine Education Program
LWD	Low Water Datum
MOU	Memorandum of Understanding
NERRA	National Estuarine Research Reserve Association
NERR	National Estuarine Research Reserve
NERRS	National Estuarine Research Reserve System
NMS	National Marine Sanctuaries
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service, NOAA
NSF	National Science Foundation
NWI	National Wetlands Inventory
OAC	Ohio Administrative Code
OCMP	Ohio Coastal Management Program

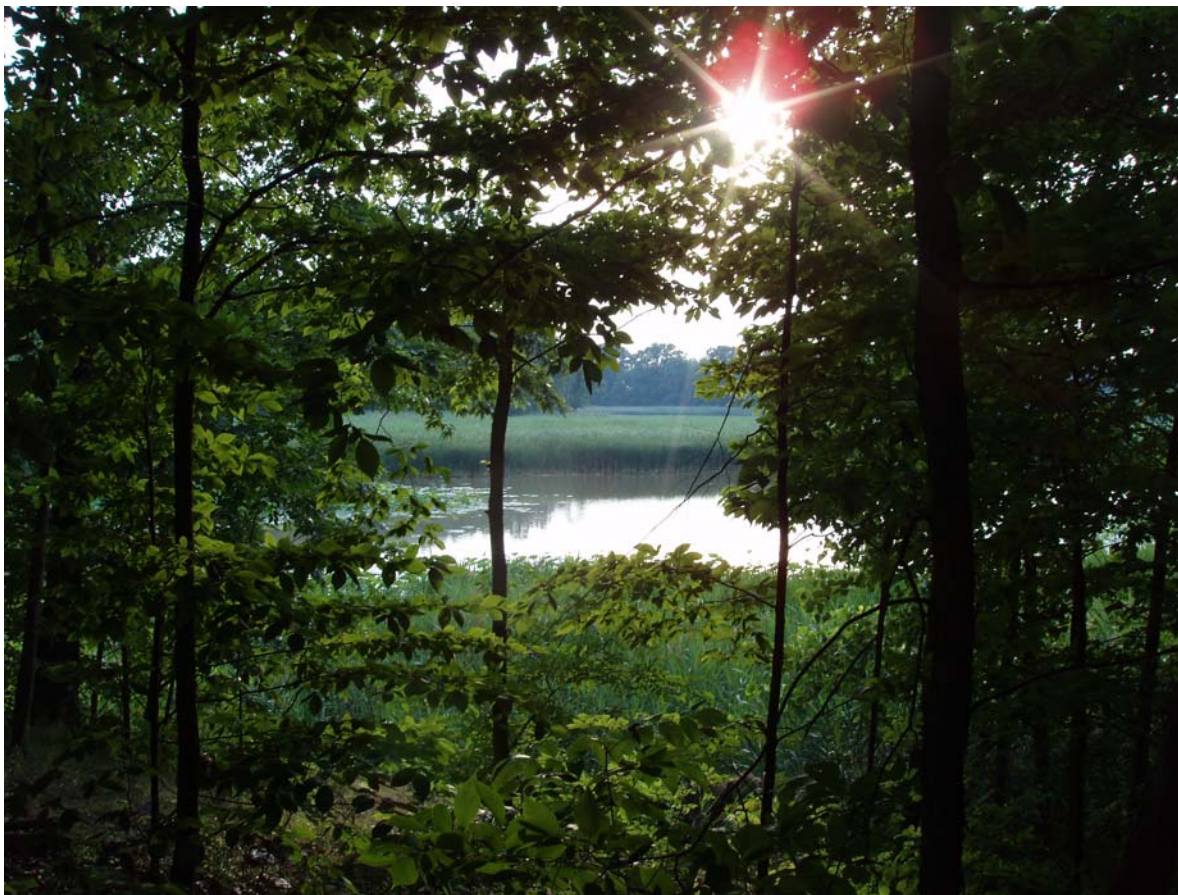
## Abbreviations and Acronyms Used in This Document (Con't.)

OCM	Ohio Office of Coastal Management, ODNR
OCRM	Office of Ocean and Coastal Resource Management, NOAA/NOS
ODNR	Ohio Department of Natural Resources
ODW	Ohio Division of Wildlife, ODNR
OH	Ohio
ORC	Ohio Revised Code
OSU	Ohio State University
OSGCP	Ohio Sea Grant College Program
OWC	Old Woman Creek
OWC NERR	Old Woman Creek Nat'l. Estuarine Research Reserve
PAGIS	Protected Areas Geographic Information System
AC	OWC NERR Reserve Advisory Council
REALM	Division of Real Estate and Land Management, ODNR
SFC	Stewardship Focus Corridor
SNP	State Nature Preserve, ODNR
SWCD	Soil and Water Conservation District
SWMP	NERRS System Wide Monitoring Program
TMDL	Total Daily Maximum Load, from Clean Water Act
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WRS	Wildlife Research Station (ODW/ODNR)



## List of Appendices

- A. Code of Federal Regulations as published in Federal Register, Part V, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, 15 C.F.R. Part 921
- B. Memorandum of Understanding Between the National Oceanic and Atmospheric Administration and the Ohio Department of Natural Resources Division of Wildlife Detailing the State-Federal Roles in the Management of the Old Woman Creek National Estuarine Research Reserve, Approved, August 2010
- C. Ohio Revised Code (ORC) Chapter 1517 Laws for Nature Preserves, Scenic River Lands, and Natural Areas
- D. Ohio Revised Code (ORC) Chapter 1531, Wildlife Laws of Ohio
- E. Research Completed at Old Woman Creek National Estuarine Research Reserve, Huron, Ohio
- F. OWC NERR Research Activities – 2010
- G. OWC NERR Technical Report and Bulletin Series
- H. Species Recorded In and Around OWC NERR
- I. Social Assessment Report, OWC Watershed (Prepared by NOAA CSC)
- J. Ohio CTP Strategic Plan
- K. Ohio CTP Needs Assessment
- L. Resource Protection Policies and Statutory Authority for OWC NERR
- M. Restoration Plan, Darrow Road Floodplain
- N. Memorandum of Understanding – ODNR Divisions of Wildlife and Natural Areas
- O. Journal Entry Transfer of Management Responsibility for OWC State Nature Preserve
- P. OWC NERR Advisory Council By-laws, as amended, May 2005
- Q. Final Evaluation Findings for The State of Ohio's Old Woman Creek National Estuarine Research Reserve, August 2003 Through August 2006, NOAA, Executive Summary
- R. Facilities Maintenance Checklist-DeWine Center for Coastal Wetlands, OWC NERR
- S. Habitat Mapping and Change Plan, NERRS, September 2009
- T. Consistency determination, Ohio Office of Coastal Management
- U. OWC NERR Visitor Center Display Concepts
- V. Lake Erie Literacy Concepts
- W. Memorandum of Understanding, ODNR-Wildlife, on behalf of the Old Woman Creek National Estuarine Research Reserve and Erie Soil and Water Conservation District
- X. Comments received during Federal Register Public Comment Period and responses, 2011



View of the Old Woman Creek estuary from trail

## Executive Summary

### **Old Woman Creek: Ohio's National Estuarine Research Reserve**

The Ohio Department of Natural Resources-Division of Wildlife (ODNR-ODW) is the state agency responsible for the operation and management of the Old Woman Creek National Estuarine Research Reserve (OWC NERR or Reserve), in cooperation with the Estuarine Reserves Division of the National Oceanic and Atmospheric Administration (NOAA). The NERR is located within the confines of the Old Woman Creek State Nature Preserve at the south shore of Lake Erie (Figure 1 on the following page).

Designated in 1980, OWC NERR is one of 28 similarly protected areas that comprise the National Estuarine Research Reserve System (NERRS). The NERRS promotes informed management of the United State's estuaries and coastal habitats.

One of the best examples of a natural freshwater estuary along Ohio's Lake Erie coast, Old Woman Creek is an ecological transition zone between land and water. The Reserve contains a variety of habitat types including marshes, barrier beach, upland mixed hardwood forests, open waters of the estuary, creek, and near shore Lake Erie.

With the approval of this management plan by NOAA, OWC NERR will increase by 2.2 acres with the addition of one parcel along the Reserve's southern boundary. This addition means that 573 acres are protected within the Reserve for future research, education, and stewardship. This plan also establishes priorities for future land conservation and expansion.

Federal regulations relevant to the NERRS require each Reserve to operate under the auspices of a NOAA approved management plan. Reserve management plans are updated on a periodic basis and serve as the framework for directing and tracking the progress of Reserve programs. The plan also provides NOAA with a basis for program evaluation. This edition of the OWC NERR management plan is the 4th version approved by NOAA and covers the period 2011-2016.

Figure 1. Old Woman Creek NERR location



## 2011-2016 Management Plan

In a series of scoping meetings with OWC NERR staff, the Reserve's Advisory Council, and other regional stakeholders, the issues on the following page were identified as the most critical confronting coastal wetlands, such as the Old Woman Creek estuary, during the plan's duration:

- Non-point source pollution
- Introductions and further infestations of non-native, aggressive aquatic and terrestrial species
- Riparian and wetland habitat loss
- Eutrophication due to factors such as nutrient loading and climatic variation

The Reserve functions as an integrated research, education and resource stewardship program. With these priority issues to address, and framed by the complementary strategic directions of the NERR partnership in Ohio, the Reserve's management plan defines specific goals to guide its programs and their administration, and to provide adequate operational support.

The OWC NERR management plan includes program plans for the Reserve's research and monitoring, education, training, and outreach, and stewardship. Additional chapters address operational support (i.e., public access, and facilities). 2011-2016 program and operational support plans are summarized below:

**Research:** Reserve staff will continue to establish baseline data and information that can facilitate management-oriented research, will continue monitoring efforts, including the NERRS system-wide monitoring program, and will develop partnerships to examine questions pertaining to significant coastal management issues.

**Education, Training, and Outreach:** Reserve staff will increase understanding of coastal resources by students, public visitors, and local officials and encourage individual and community stewardship actions.

**Stewardship:** The Reserve will take actions to ensure that the Old Woman Creek estuary is sustained through management, restoration, and planning. The Reserve will accomplish this through a scaled approach that ensures stewardship actions inside and outside Reserve boundaries. The Reserve will prioritize the acquisition of lands and waters in the area that buffers the Reserve, particularly those areas that would create the greatest ecological benefit from conservation.

**Administration:** The Reserve will effectively manage its existing resources, search for funding and additional resources that would enhance its programs, of developing and enhancing relationships with existing and new partners, and by providing direction and skill-building opportunities for staff.

**Public Access:** Through managed access, the Reserve will help visitors gain a sense of wonder and appreciation for estuarine resources.

**Facilities:** The Reserve will plan additional construction that meets existing and emerging space needs.

The implementation of this plan will advance the mission of OWC NERR to promote the understanding and stewardship of Great Lakes estuaries and coastal wetland ecosystems.



## Chapter 1. Introduction

### Estuaries: Critical National Resources

An estuary is a partially enclosed body of water where two different bodies of water meet and mix, e.g., fresh water from rivers or streams meets and mixes with salt water from the ocean or where fresh water from rivers or streams meets and mixes with one of the Laurentian Great Lakes. A freshwater estuary such as Old Woman Creek (OWC) occurs in and around the stream mouth where the flowing stream meets near-shore waters of one of the Great Lakes and often has a barrier beach at the intersection of lake and stream. The hydrologic effect of this intersection allows the development of a productive “drowned stream mouth” wetland system. Much like its marine counterparts, the OWC estuary is a biologically productive transition zone from land to sea which provides valuable services to people and the Lake Erie environment. For example, estuaries serve as nurseries for numerous animal and plant species, spawning grounds for many fish, and nesting and stopover habitat for birds. Lake Erie provides drinking water to millions of Ohioans on a daily basis. Coastal wetlands like the OWC estuary treat pollutants prior to their entry into the lake. In addition estuaries soak up flood waters and provide a buffer for near shore coastal areas as well as provide boundless opportunities for recreation and nature appreciation. In freshwater estuaries, such as OWC, water levels are affected by lunar or storm-driven tides. In Lake Erie estuaries, such as OWC, the lunar tide is small, but wind tides do produce “seiches,” (i.e., lake water sloshing back and forth), which dramatically alter estuarine conditions during storms. Because the Laurentian Great Lakes are a connected watershed, an “upstream” reduction in water levels can impact the ecology of “downstream” freshwater estuaries and coastal wetlands. The impacts of episodic storms and variability due to climate make freshwater estuaries one of the more dynamic wetland ecosystems on the planet.

### Foundation for Estuarine Conservation and Protection

All wetland ecosystems have suffered from the public’s perception of wetlands as useless, inhabitable places that are of limited value. By the 1970s, the public perception and recognition of the value of estuaries had changed. Awareness of impacts on estuaries, such as adverse impacts to water quality, fisheries, and to the overall coastal ecosystem health, had grown. The Stratton Commission’s 1969 published report, *Our Nation and The Sea*, was instrumental in focusing the attention of citizens, politicians, and scientists on the importance of our coastal regions as well as the lack of effective management (Beatley et al, 2002). The “tipping point” that produced a growing environmental movement around that time was the burning of the Cuyahoga River near Cleveland, Ohio. National magazine coverage of the fire ensured that this occurrence became a momentous event, as the river became a persistent image and rallying point for many people. That galvanizing event led to the creation of numerous environmental protection statutes including the Clean Water Act, the Clean Air Act, and the Endangered Species Act. There was also momentum for national land use planning. Congress could not agree on a tenable plan for national land use planning, but relying on the increasing evidence about the importance of the coastal regions of the U.S., focused its attention on management

of our nation's coasts. After the Stratton Commission Report, several coastal management bills emphasizing either development of the coast or coastal conservation were introduced in Congress (Beatley et al, 2002).

In 1972, Congress passed the Coastal Zone Management Act (CZMA). The legislation remains as the cornerstone of our nation's efforts to achieve sustainable development of our country's coasts.

In the CZMA, Congress recognized that the resources in coastal regions are of national significance and were under stress by many human forces. The CZMA also acknowledged the linkage between upland areas and tidelands. The CZMA is a unique federal-state collaboration. NOAA, as the federal administrator of coastal zone management, collaborates with coastal states via grant funding, technical assistance, and through ensuring that states maintain some control over federal actions that could impact that state's coastal zone.

Section 315 of the CZMA establishes the National Estuarine Research Reserve System (NERRS). Under the authority granted to the Secretary of Commerce, NOAA was directed to "acquire, develop, or operate estuarine sanctuaries to serve as natural field laboratories in which to study and gather data on the natural and human processes occurring within the estuaries of the coastal zone." (Table of organization for the NOAA National Ocean Service in Figure 2).

It is within this context of a national system of field laboratories that Ohio was granted designation of OWC as a NERR in 1980.

## **A System of Protected Estuaries: NERRS**

The reserve system is a network of protected areas established to promote informed management of the Nation's estuaries and coastal habitats. The entire reserve system currently consists of 28 reserves in 22 states and territories, protecting over one million acres of estuarine lands and waters.

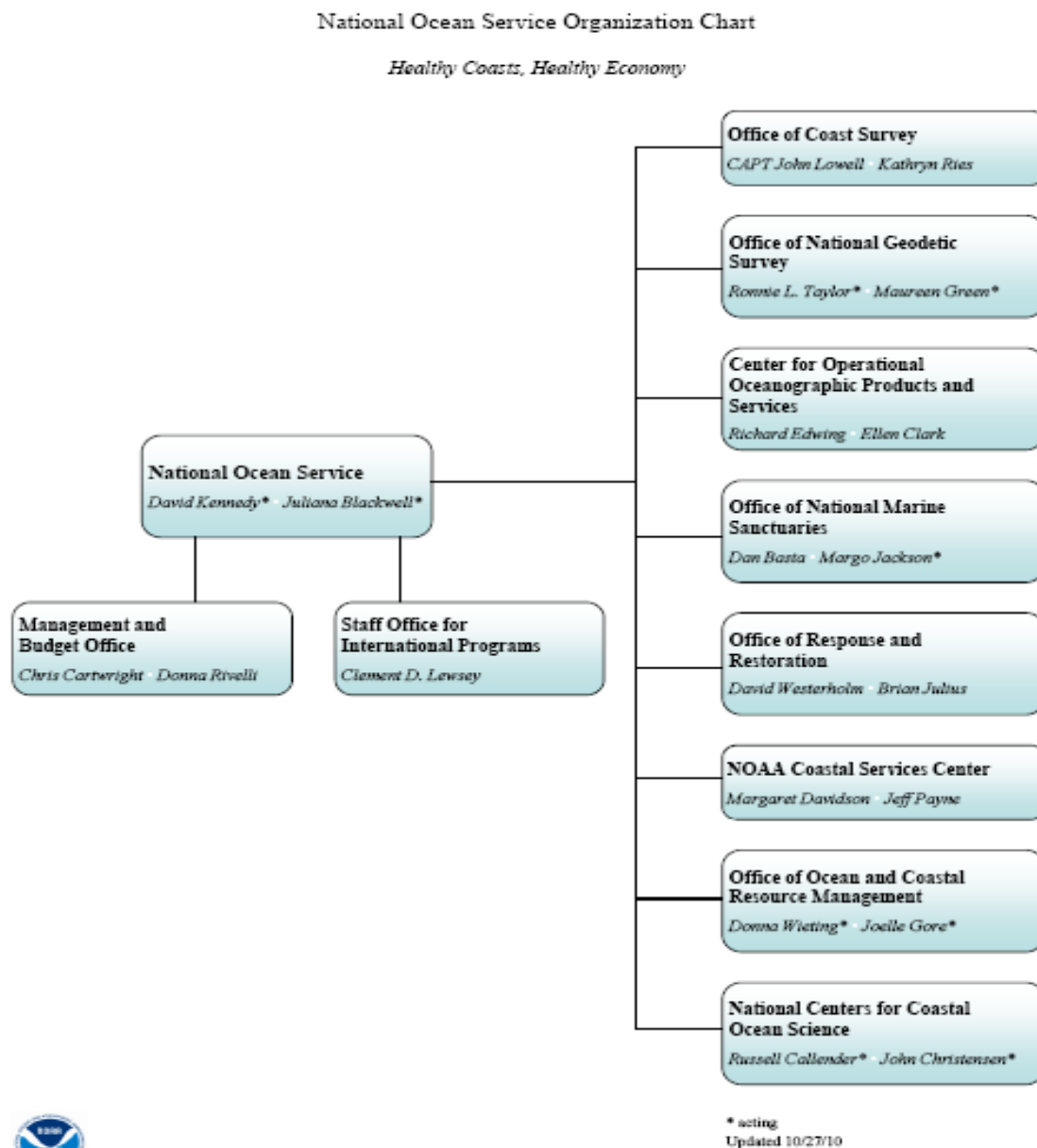
### **Mission**

As stated in the NERRS regulations, 15 C.F.R. Part 921.1(a), the National Estuarine Research Reserve System mission is:

*the establishment and management, through Federal-state cooperation, of a national system of Estuarine Research Reserves representative of the various regions and estuarine types in the United States. Estuarine Research Reserves are established to provide opportunities for long-term research, education, and interpretation.*



Figure 2. NOAA National Ocean Service table of organization



## Goals

Federal regulations, 15 C.F.R. Part 921.1(b), provide five specific goals for the reserve system:

- Ensure a stable environment for research through long-term protection of National Estuarine Research Reserve resources;
- Address coastal management issues identified as significant through coordinated estuarine research within the System;
- Enhance public awareness and understanding of estuarine areas and provide suitable opportunities for public education and interpretation;
- Promote Federal, state, public and private use of one or more Reserves within the System when such entities conduct estuarine research; and
- Conduct and coordinate estuarine research within the System, gathering and making available information necessary for improved understanding and management of estuarine areas.

## NERR System Strategic Goals 2011-2016

NOAA's Estuarine Reserves Division (ERD) and reserve staff have conducted a multi-year action planning process since 1996. The resulting plan provides an overall vision and direction for the reserve system. As part of this process, the reserve system developed a vision: Resilient estuaries and coastal watersheds where human and natural communities thrive; and mission: To practice and promote stewardship of coasts and estuaries through innovative research, education, and training using a place-based system of protected areas. The following goals are outlined in the 2011-2016 Strategic Plan.

### NERRS Goals

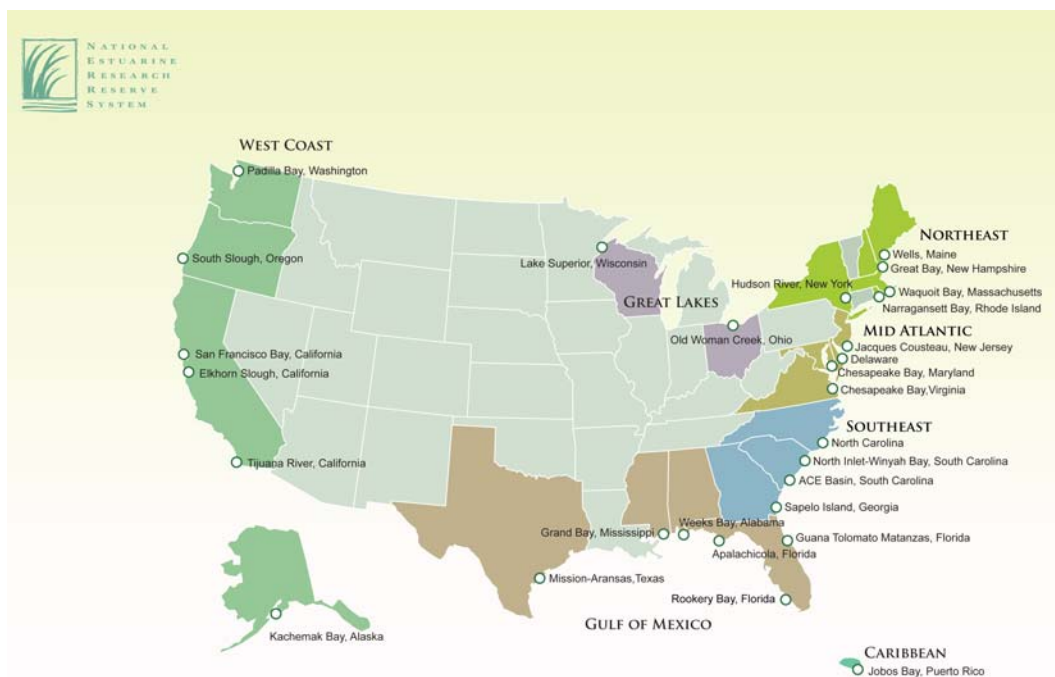
- Estuaries and coastal watersheds are better protected and managed by implementing place-based approaches at Reserves.
- NERRS scientific investigations improve understanding and inform decisions affecting estuaries and coastal watersheds.
- NERRS education and training increases participants' environmental literacy and ability to make science-based decisions relating to estuaries and coastal watersheds.

## Biogeographic Regions

NOAA has identified 11 distinct biogeographic regions and 29 subregions in the U.S., each of which contains several types of estuarine ecosystems (15 C.F.R. Part 921, Appendix I and II). When complete, the reserve system will contain examples of estuarine hydrologic and biological types characteristic of each biogeographic

region. In 2010, the reserve system includes 28 reserves with additional states expressing interest in pursuing a similar designation (Figure 3). Additional information about the biogeographic regions will follow in this chapter.

Figure 3. NERR site locations



## Administrative Framework of NERRS

The ERD, which is part of NOAA's Office of Ocean and Coastal Resource Management (OCRM) administers the reserve system. The Division establishes standards for designating and operating reserves, provides support for reserve operations and system-wide programming, undertakes projects that benefit the reserve system, and integrates information from individual reserves to support decision-making at the national level. As required by Federal regulation, 15 C.F.R. Part 921.40, OCRM periodically evaluates reserves for compliance with Federal requirements and with the individual reserve's Federally-approved management plan.

ERD provides support for four system-wide programs: the System-Wide Monitoring Program, the Graduate Research Fellowship Program, the Coastal Training Program, and the K-12 Estuarine Education Program. They also provide support for reserve initiatives on restoration science, invasive species, K-12 education, and reserve specific research, monitoring, education and resource stewardship initiatives and programs.

## **Ohio's State Agency Administration of Reserve**

The state agency responsible for partnering with the Federal level in the administration of the OWC NERR Reserve is the Ohio Department of Natural Resources Division of Wildlife (ODW). The ODW is responsible for management of fish and wildlife resources as mandated by Ohio law. The specific powers and duties of the Division are found in the three documents: 1) the Ohio Constitution; 2) the Ohio Revised Code, Sections 1531 and 1533; and 3) the Ohio Administrative Code.

The ODW holds ownership to all wild animals in trust for the benefit of Ohio's citizens. Fish and wildlife management practices, regulations, and enforcement are based on wildlife being a usable and renewable resource.

The Chief of the ODW has broad authority, with approval of the Ohio Wildlife Council, to adopt rules and regulations for managing lands and waters that will ensure sound management of fish and wildlife, to conduct management activities and to acquire property to develop and conserve the wildlife resource, and to promote programs that will educate Ohio citizens about wildlife conservation and recreation.

### **Reserve Designation and Operation**

Under Federal law (16 U.S.C. Section 1461), a state can nominate an estuarine ecosystem for Research Reserve status so long as the site meets the following conditions:

- The area is representative of its biogeographic region, is suitable for long-term research and contributes to the biogeographical and typological balance of the System;
- The law of the coastal State provides long-term protection for the proposed Reserve's resources to ensure a stable environment for research;
- Designation of the site as a Reserve will serve to enhance public awareness and understanding of estuarine areas, and provide suitable opportunities for public education and interpretation; and
- The coastal State has complied with the requirements of any regulations issued by the Secretary [of Commerce].

Reserve boundaries must include an adequate portion of the key land and water areas of the natural system to approximate an ecological unit and to ensure effective conservation.

If the proposed site is accepted into the reserve system, it is eligible for NOAA financial assistance on a cost-share basis with the state. The state exercises administrative and management control, consistent with its obligations to NOAA, as outlined in a memorandum of understanding. A reserve may apply to ERD for funds

to help support operations, research, monitoring, education/interpretation, stewardship, development projects, facility construction, and land acquisition.

### **Reserve Management Plans**

Every Reserve is required to have a NOAA-approved management plan. The plan must describe the Reserve's intended actions for research, education, public access, construction, land acquisition, resource stewardship, and facility construction plans for the upcoming five-year planned period. This revised management plan for the Old Woman Creek NERR (OWC NERR) has been developed according to NOAA regulations, using the input of Reserve and state agency staff, program stakeholders, the strategic direction of NOAA, state agency, and partner programs, as well as including NOAA's program recommendations that result from its periodic evaluations of OWC NERR.

### **OWC NERR ecological attributes (from Herdendorf et al, 2004)**

The OWC estuary ecosystem is among the few remaining natural functional coastal wetlands on the Ohio shore of Lake Erie. Coastal wetlands like the estuary of OWC perform many valuable functions such as water quality enhancement, flood and erosion control, and critical fish and wildlife habitat.

The diversity of habitats present within OWC watershed contributes to a wide variety of plant communities, each comprised of a distinctive flora. Over 800 terrestrial and aquatic species of vascular plants have been identified in the watershed and more than half of which are found within the boundaries of the Reserve, including floating-leaved plants, wildflowers, grasses, sedges, shrubs, and trees. Aquatic and wetland habitats include open water areas, mud flats, embayment marshes, swamp forests, and a variety of shoreline types. The wetlands of the estuary are essential to the survival of such important aquatic plants as the American water lotus, arrowhead, duckweed, cattails, bulrushes, water lilies, and many others.

OWC is a critical spawning and nursery habitat for many fishes. In the watershed streams, estuary, and adjoining waters of Lake Erie, 121 species of fishes have been identified, over 50 of which spend a portion of their life cycle in the estuary. Several of these species are important to the Lake Erie sport and commercial fisheries (white and black crappie, bluegill, channel catfish, bullheads, and carp), or are forage for these species (gizzard shad and shiner species). OWC also provides excellent habitat for many wetland-dependent, vertebrate species. Researchers have identified 27 amphibians, 25 reptiles, and 42 mammals within the watershed. Frogs, turtles, snakes, and muskrats are the most common types in the vicinity of the estuary.

Over 250 species of birds have been recorded in the vicinity of OWC Reserve. Numbers are greatest in the spring and fall when migrating birds stop to rest and feed before or after crossing Lake Erie. OWC is located near the intersection of the Atlantic and Mississippian flyways which further contributes to the diversity of birds utilizing the estuary, streams of the watershed, and near shore Lake Erie. Waterfowl, shorebirds, hawks, and warblers in large concentrations stop over at the Reserve during spring migration periods, mid-summer, autumn, and early winter

months. The estuary is also frequented by bald eagles during spring and fall migration, in summer following fledging of young birds, and through the winter as long as open water is present. Over 40 eagles have been observed at one time over the estuary. In 1995 the first nesting of a pair of bald eagles occurred in the Reserve and has been regular inhabitants.

Plankton and periphyton (the microscopic plants and animals floating in the water, on the bottom, and attached to plants) are found in all aquatic habitats in the Reserve. They play a major role in the estuarine ecosystem and, along with bacteria, are considered the foundation of the aquatic food web. Phytoplankton, the primary producers, are represented by over 500 algal species in the estuary. Zooplankton, the primary consumers, number over 300 species, more than 200 of which are single-celled protozoans. The bottom or macro-benthic community of animals in the estuary is represented by 13 animal phyla, composed of over 200 species. Plankton and the benthos are essential and major food items for larval, juvenile, and many adult fishes, as well as waterfowl and other birds.

## **Reserve habitats (from Herdendorf et al, 2004)**

### **Barrier beach**

OWC does not enter Lake Erie in the typical way—it must first pass through the barrier beach. At times the barrier is opened by a channel which leads to the lake, but often it is closed by sand bars. When the estuary mouth is completely sealed off by the barrier beach, the creek waters must percolate through the sand to find their way to the lake. Wind storms over the lake and rainstorms over the watershed can produce the forces necessary to breach the barrier and allow OWC to flow freely to the lake. Once these violent events have subsided however, the shifting sands of the coast can quickly close the channel and the estuary is again isolated from the open lake. The barrier is critical to the protection and maintenance of coastal wetlands. The beach allows the waves to break and roll up a gentle slope, dissipating energy and reducing the waters ability to erode the shoreline and undermine vegetation. By separating estuary from the lake, fragile aquatic plants are protected from wave attack.

The particle size of the barrier beach ranges from medium- to coarse-grained sand. The beach is predominantly made up of quartz sand. Purple and black patches or strands of garnet and magnetite, respectively, are common. The thickness of the sand is greater than 1 m (Carter and Guy 1980) and overlies glacial till that is exposed at lake level east of the beach. The xeric conditions of the barrier beach support Russian thistle, cocklebur, witchgrass, inland searocket, and velvet-leaf.

## Lower marsh

OWC NERR is located at the drowned stream mouth of a small tributary to Lake Erie. The estuarine wetlands consist of 60 hectares (150 acres) that extend 2.1 km (1.3 mi) south of the Lake Erie shore. The estuary is 0.34 km (0.21 mi) wide at its widest portion. Depths range up to 3.6 m (11.8 ft) in the inlet channel, but most of the estuary is less than 0.5 m (1.5 ft) deep. Water retention time in the estuary is generally less than a day except at times when the mouth is barred across at the barrier beach.

The main basin of the estuary is lacustrine-like and consists of a broad shallow basin that is cut by a narrow channel along its eastern margin and a secondary channel that splits off the main channel at the southern end of the basin and follows a course to the west. The channels are shallow, generally with bottom elevations a few tenths of a meter above LWD and only a few tenths of a meter below the surrounding bottom of the estuary. Star Island is located between these channels near the center of this basin. A natural levee, that is more persistent in the south basin, extends into the main basin as far north as Star Island.

The main basin is surrounded by relatively steep escarpments on all sides, including Star Island. Into the escarpments, on both sides but particularly the east side, intermittent tributaries have cut several deeply entrenched, but shallow, coves. The majority of the basin has a floor elevation ranging from +0.4 to +0.6 m LWD. This produces a depth that is particularly conducive to growth of dense beds of *Nelumbo lutea* (American water lotus). The highway and railroad constrictions at the north and south ends, respectively, of the basin are the deepest portions of the entire estuary. The channel at the U.S. Route 6 bridge is 18 m wide and has a maximum depth of -1.7 m LWD; whereas the channel at the Conrail bridge is 13 m wide and has a maximum depth of -0.9 m LWD.

Through 1999, the lower estuary was dominated by the American water lotus and to a lesser extent sago pondweed, coontail, and white water lily. The mud flats, which have expanded because of the lower water levels since 1999, are characterized by grasses, the common reed, cattail, marsh mallow, bur-reed, and water smartweed. During periods of high lake level, and for a time following such periods, vegetation can be sparse on these flats. Shoreline plants include buttonbush, common reed, dogwood, blue flag, river bulrush, cattails, and arrowhead.

The valley of OWC within the estuary has two distinct channels between the Conrail and the U.S. Route 6 bridges resulting from a bifurcation about 150 m north of the railroad. This bifurcation has preserved an isolated remnant of the lake plain known as Star Island around which the creek flowed to the east and to the west at various times. The distance between its east and west points is about 450 m and 275 m between its north and south points. The sides of the island rise rather steeply to a flat top about 9 m above the mean water level of the estuary. The entire island comprises an area of 45,000 m<sup>2</sup> (4.5 hectares) and its flat top has an area of nearly 1 hectare. Star Island is the only island in the estuary with an elevation significantly above that of the water surface.

The erosional, rather than depositional, origin of Star Island has been inferred from the accordant height of the island with the surrounding uplands and the from the largely undisturbed lake plain sediments on the island's surface. The soil types of the island, Sisson silt loam and Tuscola loamy fine sand, also match those of the surrounding upland areas of the lake plain. These soils formed in stratified limy silt and very fine sand that was deposited on the bottom of glacial lakes with levels higher than modern Lake Erie. The majority of the erosion around Star Island is believed to have occurred during a period of rejuvenation of OWC downcutting following glacial retreat. The preservation of the island remnant appears to be the result of entrenched meanders of the creek bed at that time. The arcuate gorges around the periphery of the island, forming the points of the star shape, suggest that the active channel of the creek has eroded into the island from various directions at various times. The relative steepness of these erosional scars is most likely inversely proportional to the age of the channel erosion adjacent to the slope. Thus, the gently sloping north and northwest sides of the island have the oldest shorelines and represent the oldest channels while the steeply sloping southwest side represents the youngest.

### **Swamp forest**

The south basin of the estuary is more riverine-like and is comprised of a narrow channel that extends south from the Conrail bridge to the vicinity of the Darrow Road bridge. The channel is relatively deep (maximum -0.2 to -0.7 m LWD) and flanked by natural levees along most of its course. A number of small, tributary-mouth lagoons are present along the estuary's west bank and an extensive lagoon and swamp forest is found along the east side of the estuary. This lagoon was a continuation of the main basin of the estuary, but it is now terminated on the north by the railroad causeway. The lagoon occupies an area with bottom elevations between +0.6 to +1.0 m LWD, whereas the swamp forest occurs where the bottom elevation ranges from about +1.0 to +2.0 m LWD. The deepest depths in the south basin occur in a narrow scour channel under the Conrail bridge (-0.7m LWD).

### **Mixed hardwood upland forest**

Terrestrial habitats in the Reserve are largely former agricultural fields in various stages of succession and some hardwood forests. Old field plant communities are composed primarily of successional species such as ragweed, aster, goldenrod, sumac, wild carrot, and several grasses. Elsewhere surrounding the estuary, the uplands area exhibit mixed hardwood forests of oak, hickory, maple, cherry, ash, and others with an understory of shrubs, small trees, and abundant wildflowers. Herbaceous associates of the forest communities include large white trillium, may-apple, violets, trout-lilies, cardinal flower and other woodland species. Near the railroad corridor an open prairie exhibits big bluestem, Indian grass, whorled rosinweed, butterfly-weed, ladies'-tresses, and bush clover.

The majority of the terrestrial (upland) habitats within the Reserve are covered with mixed hardwood forest. Three forest associations are present on the upland portions of the Reserve and other wooded areas of the OWC watershed: (1) oak-hickory, (2) maple, and (3) sassafras-oak-hickory. The oak-hickory association



occupies the steep banks on the eastern and western sides of the Reserve. This association is dominated by *Quercus alba* (white oak) and *Carya ovata* (shagbark hickory), with several accompanying woody species, including *Quercus palustris* (pin oak), *Quercus borealis* (red oak), *Fraxinus americana* (white ash), *Viburnum prunifolium* (black haw), and *Sassafras albidum* (white sassafras). *Trillium grandiflorum* (large-flowered trillium), *Arisaema atrorubas* (Jack-in-the-pulpit), *Erythronium americanum* (yellow trout-lily), and *Viola* spp. (violets) are conspicuous herbaceous associates in the spring, while *Cimicifuga racemosa* (black cohosh) and *Lobelia cardinalis* (cardinal flower) bloom in July, particularly in forest openings along the east bank of the estuary. South of the northern railroad bridge, the eastern upland forest merges with a swamp forest on the inundated OWC floodplain. On the western uplands, south of the railroad, a small plantation of *Pinus strobus* (white pine) thrives within the oak-hickory forest. The maple forest association occupies a small area on the eastern bluff at the mouth of the estuary. This is a lakefront woodland that lies on the north side of U.S. Route 6. Dominant trees at this site are *Acer saccharinum* (silver maple) and *Acer rubrum* (red maple). Associated woody species include *Populus deltoides* (cottonwood), *Hamamelis virginiana* (witch hazel), *Rhus glabra* (smooth sumac), and *Cornus florida* (flowering dogwood).

The sassafras-oak-hickory association exists on Star Island near the center of the main basin of the estuary. This woodland is dominated by *Sassafras albidum* (white sassafras), with *Quercus alba* (white oak) and *Carya ovata* (shagbark hickory) comprising the major woody associates. Individuals of these three taxa are generally younger than those found in the woodlands on the eastern and western uplands adjacent to the estuary, indicating more recent clearing on the island. Herbaceous dominants of the spring flora are *Trillium grandiflorum* (large-flowered trillium) and *Podophyllum peltatum* (may-apple). These taxa are significantly more abundant on Star Island than in any other woodland in the Reserve.

## **Historical and cultural perspective of the Reserve**

Archaeologists believe the ancestors of American Indians spread into North America from Asia about 20,000 years ago. These First Americans moved south and east into what is now northern Ohio shortly after the last great continental glaciers retreated northward. By about 11,000 years ago people called Paleo-Indians roamed the southern Great Lakes region, hunting mastodon (an extinct elephant), barren ground caribou, and probably other Ice Age animals.

Lake Erie was already several thousand years old by this time, and Indian people began to take advantage of the rich biological diversity among the plant and animal communities of the lakeshore. From this time on, Indian people visited the OWC estuary, living off the rich bounty that it provided.

OWC, which has been occupied off and on for the past 10,000 years, was attractive to Indian people because of its well-drained sandy soil and its strategic location. The site's location provided protected access through the estuary to the lake for fishing and commerce, and immediate entry to nearby upland forests with their rich harvest of plant foods and game.

Then, about three thousand years ago, the life of Indian people in much of eastern North America began to undergo a fundamental change, partially in response to the cultivation of certain plants for food. Cultivated plant foods supplemented a subsistence economy based on hunting, gathering, and fishing, and by about 900 A.D., Indian farmers became reliant on corn, beans, squash and sunflower for a significant portion of their food.

The major village in the Reserve was occupied during the 15th century A.D. Although the villagers farmed corn, it is believed that farming was less important to the village economy than hunting, fishing, or gathering.

For nearly 10,000 years man developed and refined methods of successfully exploiting the environment for basic needs. Although lifeways changed significantly from the Paleo-Indians to the American Indians who made contact with European settlers in the late 1700's, the importance of natural resources in everyday life remained constant. Clay from the soil, plants of the wetlands and forests, fish, birds and mammals were essential to the survival of all these native cultures.

In 1795, the Greenville Treaty was signed between the United States and the Ohio Indian tribes. This act began an era that would see the Indians lose all their Ohio lands to the early American government. In 1805, Almon Ruggles came to the OWC area to survey the land for the state of Connecticut. This territory was originally part of lands claimed by England as a result of the French and Indian War. Under a charter from the King of England, Connecticut laid claim to the territory that included all of present-day Erie County, which includes most of the OWC watershed. Following the American Revolution, colonies were requested to cede their holdings of western land to the newly formed government. Connecticut agreed to turn over its colonial holdings except for one western tract reserved for the state. During the American Revolution many residents of Connecticut had lost their property. In return for damages suffered (mainly by fire), the state agreed to give land to these citizens in lieu of monetary payment. In 1792 the westernmost 500,000 acres of the "Connecticut Western Reserve" was set aside as "The Firelands", to be divided among less than 2000 claimants.

Early Firelands pioneers found the land surrounding OWC covered by dense forests of oak, chestnut, hickory, ash, walnut, sycamore, and whitewood (tulip tree). The generally rich, sandy soils in Berlin and Huron townships were well suited for agriculture, and the climate--moderated by the proximity to Lake Erie--appeared favorable for fruit farming. Fruit trees were first brought to the OWC area from Canada in 1812, and became an important crop in the years to follow.

Historical records indicate that during the 18th century saw mills, sandstone quarries, grist mills and at least one salt well were situated within the OWC watershed. Small fruits such as strawberries, raspberries, and grapes were also introduced to this region throughout the next hundred years. Hardwood timber, particularly oak, was sought by the ship building industry in nearby Huron. This community was the largest ship building site in Ohio in the middle 1800's.

By 1879, most of the land surrounding OWC had been cleared, timber removed, and ditches opened to drain agricultural lands. These factors contributed to annual flooding of the creek, rendering its flood plain "worthless" to farmers.

The last commercial ventures in the land that would become OWC NERR or estuary began about 1880 on Star Island in the middle of the creek. At this time, the island was accessible from the mainland in dry weather via a road through the cat-tail marsh. During the winter of the next five years, the virgin hardwood timber was removed from the 10-acre island. Then, in 1899, Martin Daniels purchased the island, built a house and barn, and raised his family there. The island was planted to strawberries, raspberries, grapes, red currants and tree fruits. The Daniels family business venture met quick success. Through the early 1900's, the Daniels expanded their business to include a retail outlet on the island where tourists could buy grapes, berries, and honey. With the approach of the "Great Depression" years, fruit prices dropped and the family was forced out of business and left their island farm.

The immediate vicinity surrounding OWC National Estuarine Research Reserve has remained relatively undisturbed since the island occupation in 1920 for several reasons. Perhaps the most important factor has been the attitude of landowners controlling the critically located properties near the creek mouth. Three groups of people resisted the pressures from developers who would have altered the natural character of OWC in pursuit of recreational activities and urban expansion:

The Anderson family owned the land along the estuary's western bank from 1839 until the Ohio Department of Natural Resources purchased a portion of it for the Reserve. The upland portion of this property was farmed throughout their ownership.

The northernmost property on the west bank of OWC estuary is the Hartley homestead. This property has been in the family since the middle 1800's. Fruit and vegetable farming was the primary family occupation for two generations, and today a third generation Hartley resides on the shores of the estuary. Hartley's strong feeling of tradition has been his incentive for maintaining the land as it is.

The third property owner instrumental in keeping OWC in a relatively undisturbed condition was Oberlin College Beach Association. About 1813, Oberlin College trustees purchased several acres along the eastern banks of the creek. Cottages were built on the lakeshore portion of their property, but the southern portion along the estuary was preserved in its natural condition and has been managed as a private nature preserve throughout their ownership. The concern for the area's natural features by these landowners was a key in attracting ODNR to OWC. It was through the combined conservation efforts of these families--as well as local civic organizations, environmental groups, and interested citizens--that OWC National Estuarine Research Reserve became a reality.

## **Perspective of the Lake Erie Ecosystem**

The Great Lakes coast extends 4,600 miles along the southern shores of the lakes themselves, the largest and most utilized "inland seas" in the world. The Great Lakes are a globally significant resource, with approximately twenty percent of all freshwater on our planet and 95% of the freshwater in the U.S. contained within the lakes.

The lakes all are glacial in origin. Four major stages of continental glaciation affected the Great Lakes area during the past one to two million years. As thick ice sheets advanced into the region, they eroded soil and bedrock which was then deposited in other locations. The tremendous weight of these glaciers depressed the land surface to such an extent that isostatic rebound, the earth's gradual rising from the release of the glacier's weight, is still occurring.

About 14,500 years ago, the last of the ice sheets slowly melted and retreated, releasing large volumes of water. This meltwater and precipitation in the drainage basin collected in pools in the basins created by previous glacial scouring. As the ice margin continued to retreat, these pools enlarged to form a large post-glacial lake which is now Lake Erie. The elevation of this lake changed as retreat of the ice margin exposed lower outlets or its re-advance blocked outlets. The highest of the lake stages, called Lake Maumee, reached a maximum elevation of 800 feet above sea level. There are twelve other lower lake stages known. The shorelines of these older lakes are marked by beach ridges and wave-cut cliffs winding across northern Ohio.

Additional glacial retreat ultimately prompted a flood that drained most of the lake eastward across the Niagara Escarpment. Isostatic rebound of the escarpment as the ice retreated north raised the level of the outlet and therefore the lake's waters. About 4,000 years ago, the upper Great Lakes began to drain through the Lake Erie basin causing a rise in the lake level. The OWC estuary was formed as Lake Erie continued to rise to its present-day levels.

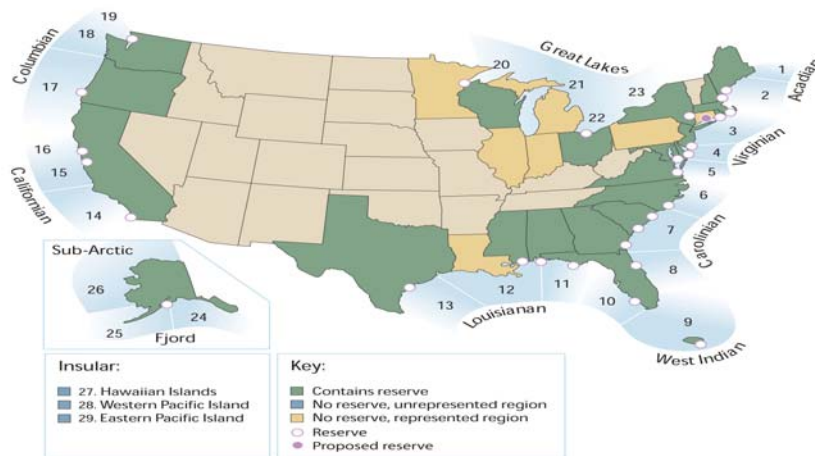
Lake Erie is the 12th largest freshwater lake in the world and has approximately 10,000 square miles of surface area making it larger than Lake Ontario, but much smaller than the other three Great Lakes. Lake Erie is the southernmost, shallowest (max. depth = 212 feet; the other Great Lakes are all over 750 feet deep), and warmest of the Great Lakes. Lake Erie is also the only lake with a watershed that is not dominated by a forest ecosystem. Land use within the Lake Erie watershed is primarily agricultural and urban. As a result, Lake Erie receives more sediment and nutrients than the other Great Lakes and is the most productive, frequently producing more fish for human consumption than the other four Great Lakes combined. In fact, during 40 of the 55 years between 1915 and 1970—including 1969 when the Cuyahoga River caught fire and the media wrote articles declaring Lake Erie to be dead—Lake Erie produced more fish than the other Great Lakes.

## Biogeographic Class of the OWC NERR

In order for an estuary to be selected to part of the NERRS, consideration is given to how well the estuary represents other natural estuaries in that particular region of the country. Because Lake Erie possesses all of the major shoreline types found in the Great Lakes, and the lake's coastal wetlands are predominantly estuary-type stream mouths, Ohio's shoreline is an ideal place to find representative estuarine systems for the lower Great Lakes.

Reserves represent different biogeographic regions of the United States. A biogeographic region is a geographic area with similar dominate plants, animals and prevailing climate. There are 11 major biogeographic regions around the coast, with 29 sub regions. The reserve system currently represents 18 of those sub regions. The reserve system is designed to include sites representing all 29 biogeographic subregions, with additional sites representing different types of estuaries. (Figure 4)

Figure 4. Biogeographic regions of the NERRS



## NERRS Biogeographic Classification Scheme

### Acadian

1. Northern Gulf of Maine (Eastport to Sheepscot River)
2. Southern Gulf of Maine (Sheepscot River to Cape Cod)

#### Virginian

3. Southern New England (Cape Cod to Sandy Hook)
4. Middle Atlantic (Sandy Hook to Cape Hatteras)
5. Chesapeake Bay

#### Carolinian

6. Northern Carolinas (Cape Hatteras to Santee River)
7. South Atlantic (Santee River to St. Johns River)
8. East Florida (St. Johns River to Cape Canaveral)

#### West Indian

9. Caribbean (Cape Canaveral to Ft. Jefferson and south)
10. West Florida (Ft. Jefferson to Cedar Key)

#### Louisianan

11. Panhandle Coast (Cedar Key to Mobile Bay)
12. Mississippi Delta (Mobile Bay to Galveston)
13. Western Gulf (Galveston to Mexican border)

#### Californian

14. Southern California (Mexican border to Pt. Conception)
15. Central California (Pt. Conception to Cape Mendocino)
16. San Francisco Bay

#### Columbian

17. Middle Pacific (Cape Mendocino to Columbia River)
18. Washington Coast (Columbia R. to Vancouver Island)
19. Puget Sound

#### Great Lakes

20. Lake Superior, including St. Marys River (**Lake Superior NERR, 2010**)
21. Lakes Michigan and Huron, including Straits of Mackinac, St. Clair River, and Lake St. Clair
22. Lake Erie, including Detroit River and Niagara Falls (**OWC NERR**)
23. Lake Ontario, including St. Lawrence River

#### Fjord

24. Southern Alaska (Prince of Wales Island to Cook Inlet)
25. Aleutian Islands (Cook Inlet to Bristol Bay)

#### Sub-Arctic

26. Northern Alaska (Bristol Bay to Demarcation Point)

#### Insular

27. Hawaiian Islands
28. Western Pacific Islands
29. Eastern Pacific Islands

Most tributaries flowing into Lake Erie along Ohio's shore have been impacted by development. Ports, marinas, industrial complexes, residences, and recreational facilities have been attracted to these coastal areas. Only a few remnants of Lake

Erie estuarine areas remain, and OWC is one of the best examples of this wetland type. Located within the central basin of Lake Erie, OWC has a diversity of habitats that make it ideally suited as a protected field laboratory. These distinct habitats include:

- drowned stream mouth freshwater estuary
- barrier beach
- glacial till and lacustrine-sediment bluff
- marsh
- swamp forest
- upland hardwood forest
- island within the lower section of the estuary

### **OWC NERR Boundary**

The OWC NERR boundary corresponds to the boundary of the state nature preserve. An additional 2.2 acre parcel is proposed for inclusion as part of this plan (Area bounded in green in Figure 5). This area was incorporated within the state nature preserve in 2004 and is hereafter incorporated within the Reserve boundary. The land is subject to all protection afforded by Ohio laws governing state nature preserves (ORC 1517).

### **Core and buffer areas of the OWC NERR**

As described in the regulations for the NERRS, the Reserve boundaries encompass two areas: 1) **core area**), and 2) a **buffer zone**. The term "key land and water areas" refers to that core area within the Reserve that is so vital to the functioning of the estuarine ecosystem that it must be under a level of control sufficient to ensure the long-term viability of the Reserve for research on natural processes. Key land and water areas, which comprise the core area, are those ecological units of a natural estuarine system which preserve, for research purposes, a full range of significant physical, chemical and biological factors contributing to the diversity of fauna, flora and natural processes occurring within the estuary. The determination of which land and water areas are key to a particular Reserve must be based on specific scientific knowledge of the area. A basic principle to follow when deciding upon key land and water areas is that they should encompass resources representative of the total ecosystem, and which if compromised could endanger the research objectives of the Reserve. The core area designation is consistent with state nature preserve policies for protection of the estuary and its resources. Allowable activities (via permit) within the core area include:

- Research and monitoring
- Scientific collection
- Land access off designated trails and public use areas
- Water access
- Hunting (in controlled hunting events)

The buffer zone is defined as the area adjacent to or surrounding key land and water areas and essential to their integrity. Buffer zones protect the core area and provide additional protection for estuarine-dependent species, including those that are rare or endangered. When determined appropriate by the state and approved by NOAA, the buffer zone is also the area for facility development required for research and

interpretation. Additionally, buffer zones should be established sufficient to accommodate a shift of the core area as a result of biological, ecological or geomorphological change which reasonably could be expected to occur. The buffer area of the OWC NERR is currently designated as zones in which facility development has previously taken place or could take place in the future within the state nature preserve's boundary. Most of the Reserve's publicly accessible lands and facilities are within the buffer area.

Because of varying water cycles on Lake Erie, the OWC estuary has shown the ability to adapt to change effectively. Through high water and low water periods, estuarine communities change and adapt to the shift in water depth and surface coverage. The Reserve research and monitoring program will continue to perform trend analysis of this adaptability feature of the estuary and consider modifications to its boundary to increase buffer zones to insure its integrity.

Activities within the Reserve buffer zone, with the exception of water access on Lake Erie, require a permit for activities as listed for the Reserve's core area per state nature preserve regulations, since both areas are contained within the jurisdictional boundary of the state nature preserve. Figure 6 shows the Reserve core areas in red and buffer areas in tan.

### **OWC NERR acquisition plan**

The existing boundary of the OWC NERR does not include about 500 acres of upland buffer areas that were specified in the originally proposed Reserve acquisition plan. In response to citizen concerns, the ODNR reduced the originally proposed Reserve boundaries. In the years that followed site establishment, local attitudes toward the Reserve have improved. OWC NERR management undertook regular discussions with local landowners about the benefits of conserving lands and riparian areas upstream of the Reserve, which might over time be added to Reserve boundaries.

As part of nominating a NERR, states are given an option to develop multiple component sites. Management plans for multiple component sites must address goals and objectives for each component and identify / establish the additional component's relationship to the original site (15 CFR 921.33). Since the OWC NERR was designated, both NERR and ODNR have explored the possibility of designating a regional system for the Ohio Reserve. Among the sites that have been considered are Sheldon Marsh SNP, DuPont Marsh SNP (both in Huron), and North Pond SNP on Kelley's Island. Although these protected areas would have potential as comparison sites and are suitably governed by state statues to ensure a stable platform for long-term research and monitoring, such a multi-component alignment is not planned within the scope of this management plan. The Reserve acquisition strategy focuses on protecting riparian buffer areas south of the existing boundary. There is more discussion about the Reserve's land conservation strategy in the stewardship chapter.



Figure 5. OWC NERR Boundary with addition

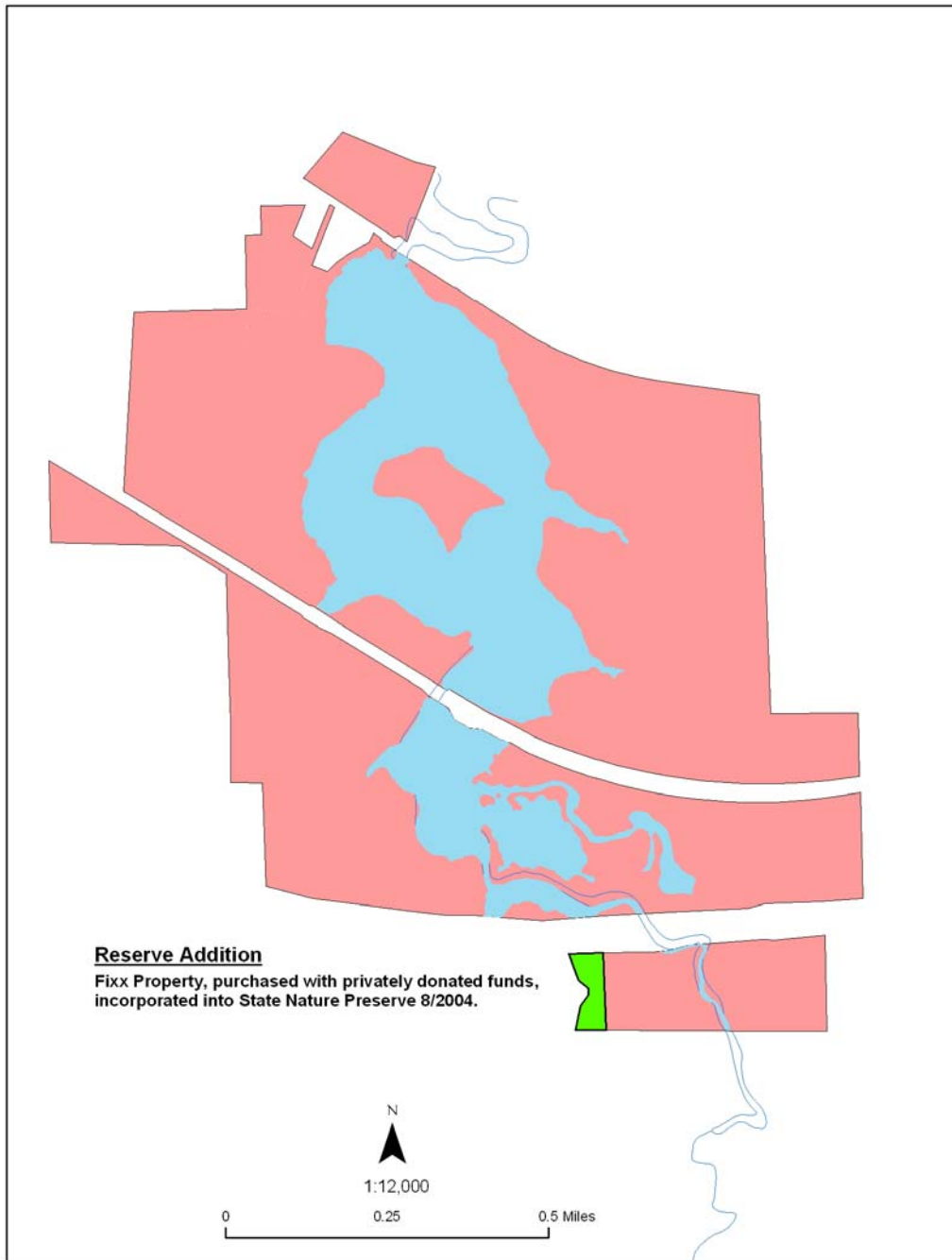
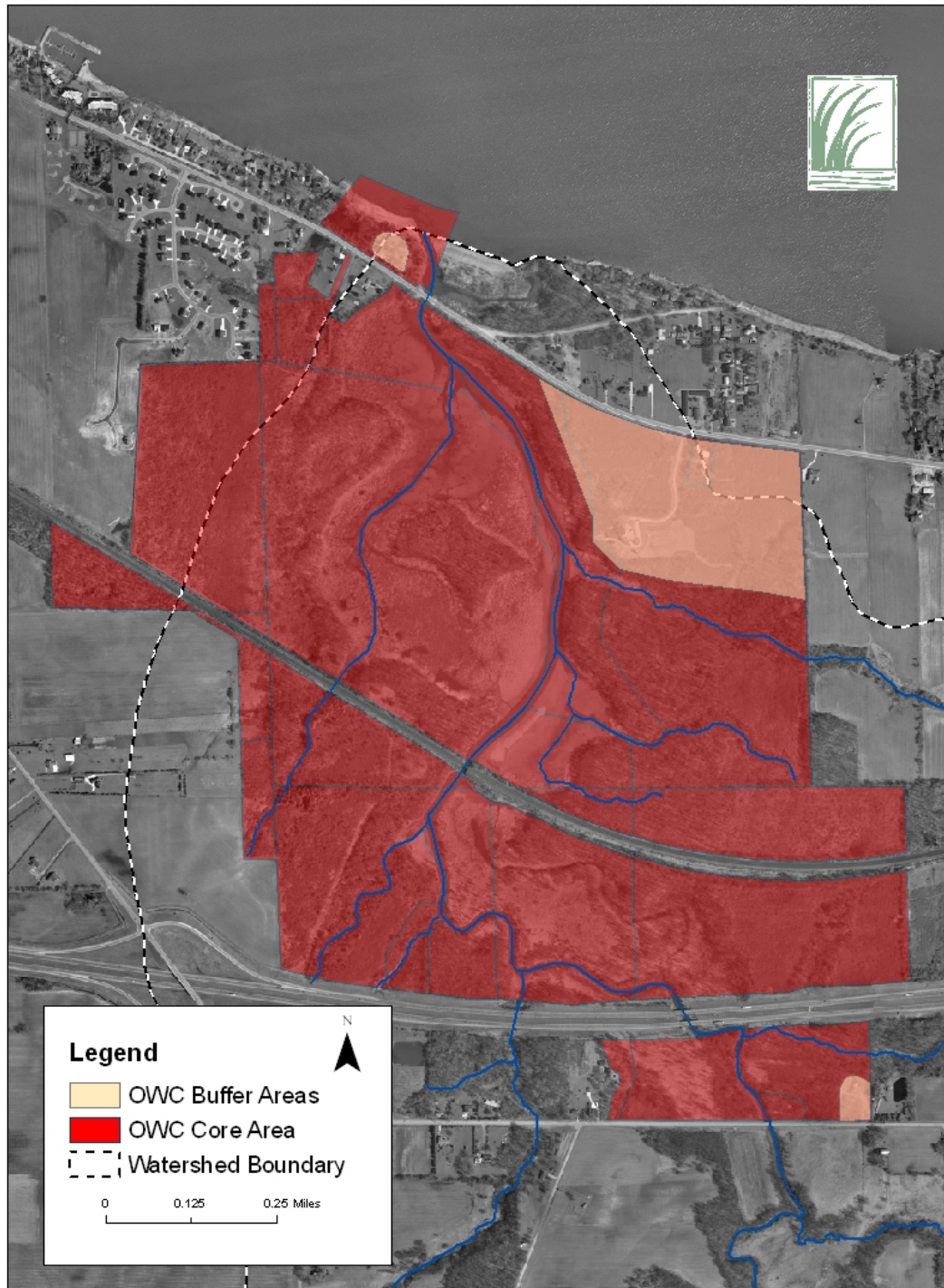


Figure 6. OWC NERR core and buffer areas



**References**

Beatley, T., Brower, D.J., and Schwab, A.K., 2002. *An Introduction to Coastal Zone Management* (2nd Ed.) Island Press: Washington, D.C. 329 pp.

Herdendorf, C.E., D.M. Klarer, and R.C. Herdendorf. 2004. *The Ecology of Old Woman Creek, Ohio: An Estuarine and Watershed Profile*. Ohio Department of Natural Resources, Division of Natural Areas and Preserves, Columbus, Ohio. 448 pp.

### **Purpose and Scope of this Management Plan**

The plan contains the collective vision, mission, goals, and objectives of the OWC NERR, and establishes policies for the sustainability of the natural resources and for the maintenance of the ecological balance of the Reserve. The plan provides guidance for the administration of Reserve operations, resource stewardship, research, education, public engagement, and infrastructure for the next five years. This plan also describes the necessary elements of site-specific ecological management that identify key natural resources, determine the appropriate level of human use for the sites and these resources, and foster their long-term stewardship. The goals, objectives, and action strategies reflect the collective input of Reserve and other Division of Wildlife staff, plus stakeholders like the OWC NERR Advisory Council and the Friends of OWC.

This document is the fourth edition of the Old Woman Creek National Estuarine Research Reserve (hereafter referred to as OWC NERR or “the Reserve”) management plan, revising the version adopted in 2000, and will be implemented from 2011-2016. The third edition of the OWC NERR management plan was approved by the National Oceanic and Atmospheric Administration (NOAA) in 2000. The original OWC NERR management plan was approved in 1981 and revised in 1982. The third edition was approved the following year (1983).

A great deal has been accomplished by the OWC NERR since the last version of the management plan was adopted. The Reserve is committed to building upon past progress through the implementation of this plan.

Until 2004, administration and management of the OWC NERR rested within the Ohio Department of Resources, Division of Natural Areas and Preserves (ODNR-DNAP). In October 2004, administration and oversight of the OWC NERR transferred internally within ODNR to the Division of Wildlife (ODW).

In light of the administrative change, this fourth edition of the OWC NERR Management Plan is reflective of mutual priorities of the National Estuarine Research Reserve System (NERRS) and the ODW. The Reserve also strives to maintain consistency with strategic directions of its primary state agency partners in Ohio including the Ohio coastal management program, the Ohio Sea Grant, and the Lake Erie Commission.

The OWC NERR was officially designated by NOAA in September 1980 and represents lower Great Lakes estuaries in the NERR system. The Reserve program in Ohio is a relatively “mature” and stable program with an experienced staff, adequate facilities, and core estuarine areas protected for long-term research and monitoring. The involvement of ODW and its mission to conserve fish and wildlife resources provides an opportunity for the Reserve to address new and emerging priorities in wetland management-oriented research, education, and stewardship.

Just as is the case in many other lower Great Lakes coastal wetlands, the Reserve is impacted by several issues that shaped the strategies of this management plan.

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These issues include:

- Non-point source pollution in the watershed
- Introductions and further infestations of non-native, aggressive aquatic and terrestrial species
- A loss of riparian and wetland habitat in the OWC ecosystem, including its watershed
- Potential eutrophication impacts from climatic change and variability.

Over the next five years, it is the vision of the OWC NERR to confront these issues and maintain its role as the leading source of excellence for education, information, and scientific research opportunities focusing on lower Great Lakes estuaries and similar coastal wetlands. Specific directions for the OWC NERR program include:

- Establishing new and maintain existing research and monitoring collaborations in Ohio and the Great Lakes
- Working collaboratively to ensure that coastal wetland research influences individual and community scale resource decisions
- Prioritizing community stewardship of the estuary, watershed, and Lake Erie through networked planning and implementation efforts
- Enriching visitor experiences to the Reserve through low impact access opportunities and an updated learning environment in the visitor center
- Responsibly managing core Reserve areas and seek out opportunities to protect adjacent buffer lands and waters

This management plan has been developed in accordance with National Oceanic and Atmospheric Administration (NOAA) regulations, which includes all provisions for public involvement. It is consistent with the congressional intent of Section 315 of the Coastal Zone Management Act of 1972 (CZMA), as amended. The plan will be instrumental in guiding the future direction of the OWC NERR by its administration and staff, and its implementation will be evaluated in subsequent required program evaluations (15 C.F.R. Part 921.40).

The Reserve is an integrated program of research and education that promotes the sustainable use and protection of Great Lakes estuaries, coastal wetlands, and their watersheds. This management plan has *goals* that cross its various administration, research, education, and stewardship activities. *Objectives* define how the Reserve will gauge its progress toward desired outcomes. Many of the plan's objectives cross program areas, as well. Specific *actions*, which may be through the collaborative efforts of multiple programs and staff, are how the Reserve intends to implement this plan to work toward overall goals and objectives. The plan describes these actions, offers the rationale that led to their development, and the program areas that will be engaged in implementing the actions.

To use this plan, we suggest that you read it in the following manner:

- By noting the action plan priorities of each program area for the five year planning period, then referring to details of particular interest throughout the chapter which support the decision making process that shaped specific actions

Through the on-site administration and management of the Reserve, OWC NERR performs and develops partnerships to secure long-term research, collects monitoring 28 data, and provides educational opportunities for the public and resource managers designed to encourage stewardship of the estuary and similar coastal wetland ecosystems of the Great Lakes. The OWC NERR is a mutually beneficial partnership between NOAA and the ODW.

## **Plan summary**

The vision and mission of the collective programs of the OWC NERR reflects an acknowledgement of the Reserve's role in the stewardship of coastal wetland ecosystems within the Great Lakes region and to serve as an example of stewardship practice implementation.

### **Vision of OWC NERR**

OWC NERR is a regional leader in the stewardship and conservation of a Great Lakes estuarine ecosystem

### **Mission of OWC NERR**

Improving the understanding, stewardship, and appreciation of Great Lakes estuaries and coastal wetland ecosystems

In order to fulfill the OWC NERR mission, the Reserve must continue to improve scientific understanding of the estuary, its role in the Lake Erie ecosystem and the effects of external forces (natural and anthropogenic) on ecosystem health. The Reserve's wealth of information about the estuary's ecology frame management-oriented research questions from Reserve and other partner scientists. The Reserve provides education and training that encourages stewardship of OWC, other Great Lakes estuaries and their watersheds. The Reserve's vision and mission point to a bifurcated approach, wherein stewardship research, education, and direct management actions taken to protect the OWC estuary are transferred to benefit other regional coastal ecosystems. This allows the Reserve to serve as a "proving ground" for Great Lakes freshwater estuarine stewardship methods and practices.

## **Priority issues addressed by this plan**

Coastal wetlands like the OWC Reserve are at the intersection of the environmental challenges facing the entire Lake Erie ecosystem. To guide the development of this management plan, the Reserve conducted a scoping process. Public stakeholders and staff examined priority issues of regional plans like the Lake Erie Protection and Restoration Plan (2008). Four regional and localized issues were identified that provide a foundation for many of the actions contained within this plan. Additional issues that must be addressed to ensure the stewardship of the OWC estuary and watershed are presented in Chapter 5.

## 1) The management of non-point source pollution

Lake Erie is the only Great Lake that has a watershed predominately in agricultural and urban land use. All of the other lakes have forested ecosystems. The stress brought about from these land uses is a threat to Lake Erie, which is also the most biologically productive of all the Great Lakes. The good news is that Lake Erie and its surrounding Ohio watersheds have improved significantly since the dark days of the 1960s and 1970s when the Lake was a national embarrassment for Ohio. The *Lake Erie Quality Index*, released by the Ohio Lake Erie Commission most recently in 2004, evaluated 11 separate indicators of Lake Erie quality. Water quality has begun to decline again after having previously improved. Recent increases in soluble phosphorus apparently combined with the affects of the zebra and quagga mussel invasions have resulted in an increase in algal blooms and related declines in water clarity and quality. Noxious algae blooms have reappeared in the Western Basin and the so called “dead zone” or area of low to zero oxygen levels has been expanding in the Lake’s central basin, in the vicinity of the OWC NERR Reserve.

This presents distinctive opportunities for the Reserve in focusing its research, education, and stewardship efforts on reducing the impacts of non-point source pollution from agricultural and urban landscapes through the management of stormwater and improved wastewater treatment practices.

There are no centralized wastewater treatment systems within the OWC watershed. All businesses and households operate with on-site septic systems. Failing systems jeopardize public health and contribute to high nutrient and bacteria loads downstream.

## 2) Aquatic and terrestrial invasive species

Throughout the Great Lakes, there is no ecosystem management issue more confounding than invasive species.

The ballast water from lake-borne commerce is a prime pathway for the introduction of invasives into the lakes and near shore areas. Over 180 documented aquatic invasive species have entered the Great Lakes with nearly three quarters of that total coming in since the St. Lawrence Seaway opened the region to the Atlantic Ocean in 1959. Additional invasions happen on a monthly basis. Within Ohio, both aquatic and terrestrial species continue to be of great concern. Round goby, zebra and quagga mussels, sea lamprey, purple loosestrife, garlic mustard, emerald ash borer, and *Phragmites* are just a few of the species that have been introduced in the Lake Erie watershed. These aggressive species out-compete native species, creating monocultures which lack the diversity necessary to support the intricate food web that has evolved around Lake Erie’s productive ecosystem. Beyond food web and habitat impacts, species such as mussels have impacts on the water column and nutrient cycling that scientists are still working to fully comprehend. A potential link between mussels and harmful algal blooms illustrates how these invasive species alter the dynamics of the system and further complicating attempts to manage and improve the quality of Lake Erie and its tributaries. The compounding impact of climate change will likely have additional impacts on the viability and distribution of invasive species into the future.

Many of the species have detrimental impacts on coastal wetland areas like the OWC estuary. As a result, rapid identification, response, and control actions are proposed to reduce the impacts on invasions on the Reserve. On the other hand, the unique habitat of coastal wetlands like the OWC estuary is refuge for some native species (e.g., *unionid* mussels) threatened by invasive species on Lake Erie.

### **3) Loss of wetland and riparian habitat within the Lake Erie watershed**

Ohio ranks second to California in the U.S. in percentage of historical wetland acreage lost. Much of the wetlands in the Lake Erie basin were successfully drained and ditched for agricultural use. Wetland loss, especially coastal wetlands, impacts water quality and species diversity in Ohio, across the Great Lakes, and on an international scale. Coastal Lake Erie wetlands serve as rest stops for migrating avian species utilizing heavily traveled flyways that span across North and South America. Ohio's coastal wetlands also served as the last refuge for bald eagles during the late 1970's when their numbers hit an all-time low.

In the OWC and other Lake Erie-basin watersheds, there continues to be potential for restoring wetland habitats, as well as returning natural flow regimes to streams and tributaries.

### **4) Ecosystem impacts of regional climate change**

The anticipated impacts of climate change in the Great Lakes include a reduction of lake levels, impacting all connected coastal wetlands. Water levels in the OWC estuary are a driver of ecological conditions. Lower lake levels could result in further damage to wetlands, resulting in poorer water quality in Lake Erie due to the loss of regional wetland filters and degradation of wildlife habitat.

This plan identifies actions that will help Lake Erie basin citizens and communities reduce the rate of climate change, prepare for its impacts, implement its own environmentally-responsible practices, and assist with the sustainable development and responsible use of alternative energy technologies.

The Reserve is ideally suited to serve as a sentinel of climate change for other coastal wetland ecosystems. To serve this function, the Reserve must continue to document its ecological conditions and how climate and weather variability impact the estuarine ecosystem, including the phenology of native fish, wildlife, and plant species.

## **Organization of the Management Plan**

This management plan has been developed to address specific objectives of the Reserve's research, education, stewardship programs, its administration functions, and critical program elements such as land conservation, facilities, and public access over the next five years (2011 – 2016). The management plan's goals, objectives, and actions are consistent with the NERRS and the Ohio Division of Wildlife strategic planning documents.



## **OWC NERR Goals and Objectives**

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Goals and objectives the Reserve will meet in this plan have been developed through examining priority Great Lakes ecosystem issues and by mapping a strategy that complements the strategic plans of its partners, NOAA-NERRS and the ODW. Program plans of other collaborators and partners were examined to identify alignments, thereby identifying areas for potential collaboration in the implementation of planned actions. The Reserve will continue to foster partnerships in areas that will lead to the completion of its planned actions.

The strategic references for the matrix of planned OWC NERR actions are:

- NOAA: NERRS Strategic Plan, 2011-2016; NOAA Education Strategic Plan, 2009-2029
- Ohio Division of Wildlife Strategic Plan: The Next Generation of Ohio's Conservation Journey 2010
- Ohio Coastal Management program document and OCM Strategic Plan 2008-2013
- Ohio Sea Grant College Program Strategic Plan, 2010 – 2014 Strategic and Implementation Plan
- Lake Erie Protection and Restoration Plan 2008
- Old Woman Creek Watershed Plan 2010

Quantifiable metrics in Reserve objectives and actions have been developed through the Reserve's historical averages (e.g., number of education programs) and defined restoration targets (e.g., 25% reduction in sediment loading).

Table 1 on the following pages displays 2011 – 2016 goals, objectives, and responsible program areas.

GOAL	OBJECTIVES	PROGRAM AREAS
<b>Improve scientific understanding of the estuary, watershed, and Lake Erie</b>	Reserve ecological conditions are monitored and indicators are developed to serve as a foundation for management-oriented research and for estuarine education	E, R, S
<b>Foster connections to the Old Woman Creek estuary and other coastal ecosystems</b>	Students are attracted to coastal resource management professions	A, E, R, S
	The Reserve's learning environment and the experiences of visitors and users are enhanced	A, E, R, S
	Volunteer service on behalf of the Reserve increases	A, E, R, S
	A networked organization with sufficient capacity to meet program goals and objectives	A, E, R, S
<b>Inform decisions of Lake Erie communities and individuals regarding coastal ecosystems</b>	Reserve science and technical expertise is transferred to estuarine stakeholders	A, E, R, S
	50 citizens adopt or install stewardship practices because of Reserve education programs	A, E, S
	3,000 coastal decision-makers receive science based training and information that supports coastal stewardship	E

Program Area Key:  
A - Administration  
E - Education  
R - Research  
S - Stewardship

GOAL	OBJECTIVES	PROGRAM AREAS
<b>Enhance the OWC NERR's role as a regional focal point for wetland stewardship science, practice implementation, and education</b>	Reserve ecological conditions are monitored and indicators are developed to serve as a foundation for management-oriented research and estuarine education	R, S
	Volunteer service on behalf of the Reserve increases	A, E, S
	Reserve science and technical expertise is transferred to estuarine stakeholders	A, E, R, S
	Sediment and nutrient loading into the estuary is reduced by 25%	A, S
	30 acres of the estuary impacted by aquatic invasive species are restored to native aquatic vegetation	R, S
	Buffer lands and waters are protected through the Reserve's land conservation strategy	A, S
<b>Maintain effective and professional program operations</b>	A networked organization with sufficient capacity to meet program goals and objectives	A, R
	The effectiveness of Reserve education programs are measured by needs assessment and evaluation strategies	E

Program Area Key:  
A - Administration  
E - Education  
R - Research  
S - Stewardship



OSU researcher Alexandra Hakala collects sediment cores for pore water extraction from the estuary

## Chapter 3. Research and Monitoring Plan

The reserve network of living laboratories provide a mechanism for addressing scientific and technical aspects of coastal management problems through a comprehensive, interdisciplinary, and coordinated approach. Research and monitoring programs, including the development of baseline information, form the basis of this approach. Reserve research and monitoring activities are guided by the reserve system research and monitoring plan which identifies goals, priorities, and implementation strategies. This approach, when used in combination with the education and outreach programs, will help ensure the availability of scientific information that has long-term, system-wide consistency and utility for managers and members of the public to use in protecting or improving natural processes in their estuaries. Research within the reserves is designed to fulfill the reserve system goals as defined in program regulations. These include:

- Address coastal management issues identified as significant through coordinated estuarine research within the System;
- Promote Federal, state, public and private use of one or more reserves within the System when such entities conduct estuarine research; and
- Conduct and coordinate estuarine research within the System, gathering and making available information necessary for improved understanding and management of estuarine areas.

### Reserve System Research and Monitoring Guidelines

#### Reserve System Research Funding Priorities

Federal regulations, 15 C.F.R. Part 921.50 (a), specify the purposes for which research funds are to be used:

- Support management-related research that will enhance scientific understanding of the Reserve ecosystem;
- Provide information needed by reserve managers and coastal ecosystem policy-makers; and
- Improve public awareness and understanding of estuarine ecosystems and estuarine management issues.

The reserve system has identified the following five research areas to complement the funding priorities outlined above:

1. Habitat and ecosystem processes
2. Anthropogenic influences on estuaries
3. Habitat conservation and restoration
4. Species management
5. Social science and economics

NOAA is a primary research funding source at NERRS sites, and its research funds are preferentially awarded to proposals which reflect NOAA's national research priorities. Although NOAA-supported research may be oriented to a specific reserve, projects that benefit more than one reserve are given higher priority.

NOAA regulations specify the purposes for which research funds are to be used, 15 C.F.R. Part 921.50 (a): Found in Appendix A

- support management-related research that will enhance scientific understanding of the reserve ecosystem
- provide information needed by reserve managers and coastal ecosystem policy-makers
- improve public awareness and understanding of estuarine ecosystems and estuarine management issues.

NOAA encourages coordinated research among reserves and other scientists by preferentially funding research proposals on specific estuarine topics which it has identified as national priorities. This unified approach promotes the exchange of research findings among reserves, state and federal agencies, and members of the academic research community.

There are three NERRS avenues to fund estuarine research across the span of the national Reserve system. The Graduate Research Fellowship Program (GRF) supports students to produce high quality research in the reserves. The NERR System-wide Monitoring Program (SWMP, pronounced "swamp") provides researchers, resource managers, educators, and other coastal decision makers with standardized, quantitative data to determine how reserve conditions are changing in both the short-term and the long-term. A more thorough description of the SWMP can be found within the monitoring plan in this chapter. Finally, the NERR Science Collaborative brings management-oriented research to coastal communities.

### **Graduate Research Fellowship Program (GRF)**

The GRF program, implemented in 1996, supports high quality research in the NERRS. Each fellowship provides 1-3 years of funding for a graduate student to conduct research. The fellowship requires that each graduate student assist the Reserve in its monitoring, research, Coastal Training, and/or education programs. Projects must address coastal issues identified as having regional or national significance and relate them to the individual reserve's research focus areas. GRF funds are available on a competitive basis to students enrolled in a full-time Masters or Doctoral program at U.S. accredited colleges and universities.

Applicants must address one of the nationally significant research priorities established by the NERRS and conduct research in one or more of the reserves.

The NERRS Research priorities (2008) focus on the following areas: `

- eutrophication, effects of non-point source pollution and/or nutrient dynamics;
- habitat conservation and/or restoration;
- biodiversity and/or the effects of invasive species;
- mechanisms for sustaining resources within estuarine ecosystems; or
- economic, sociological, and/or anthropological research applicable to estuarine ecosystem management.

Current GRF research objectives and application procedures are available online at <http://nerrs.noaa.gov/Fellowship.aspx>.

### **NERR Science Collaborative**

The Science Collaborative is a program designed to put NERRS-based science to work in coastal communities. The program funds and supports Reserve-led research projects that bring scientists, intended users of the science, stakeholders, educators, and trainers together to address problems related to coastal pollution and habitat degradation in the context of a changing climate.

The Science Collaborative selects projects through annual competitions, designed to ensure that research project teams, which include Reserve staff, intended users of the science, and relevant stakeholders work together to describe science and technology needs to address specific problems, define research questions, design and implement projects, and apply the results.

### **Reserve System Research Goals**

The reserve system research goals are embedded in the Science Goal of the Reserve System Strategic Plan 2011-2016, 'NERRS scientific investigations improve understanding and inform decisions affecting estuaries and coastal watersheds,' and outlined several objectives. They include:

- Expand capacity to monitor changes in habitat and water quality and quantity in response to land use and climate change drivers.
- Improve understanding of the effects of climate change and coastal pollution on estuarine and coastal ecology, habitats, and ecosystem processes.
- Characterize coastal watersheds and estuary ecosystems and quantify ecosystem services to support ecosystem-based management of natural and built communities.
- Increase social science research and use of social information to foster coastal stewards that value and protect estuaries.

### **Research Plan of OWC NERR**

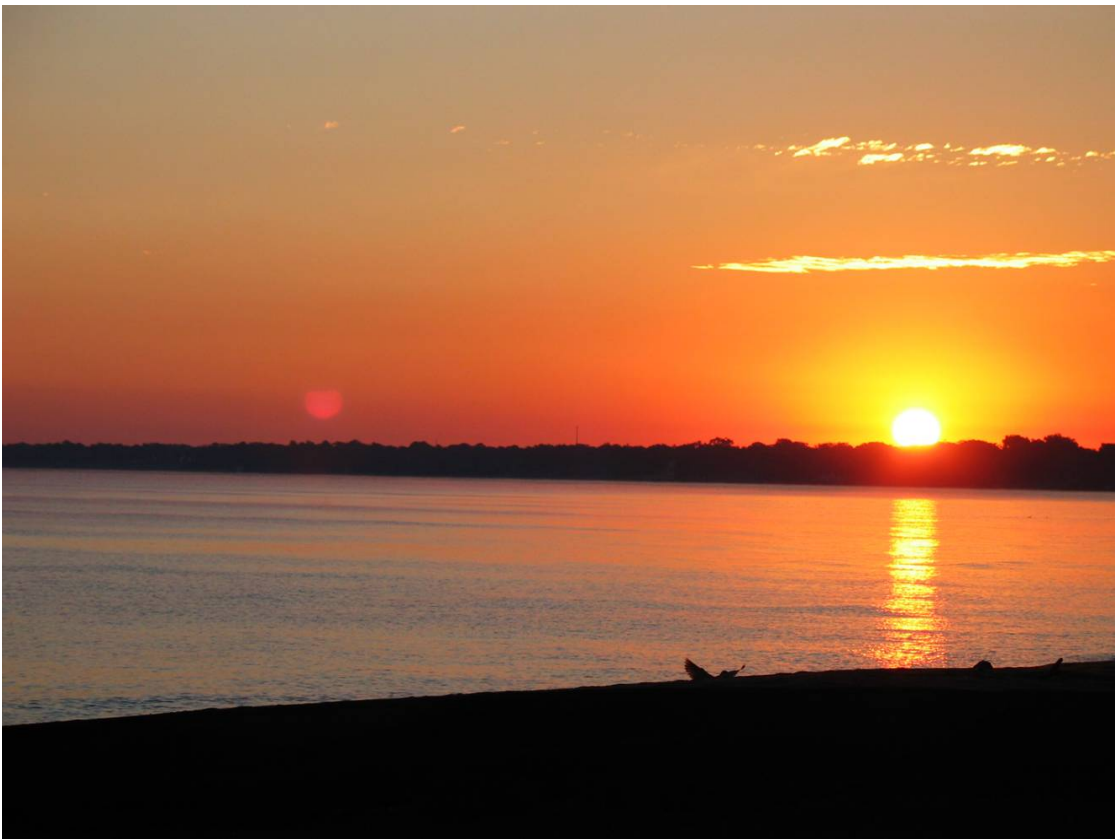
The research and monitoring program at OWC NERR seeks to develop a comprehensive scientific understanding of natural and human processes occurring within the estuary, watershed, and Lake Erie; and to provide the information necessary for proper management, use, and restoration of freshwater estuaries and other coastal habitats in the Great Lakes.

Over the next five year period, the OWC NERR research program, including its partner institutions, will address a range of ecological and management issues. Of these issues, several frame research questions about significant ecosystem issues:

- Fluctuating Lake Erie water levels have caused changes in estuarine and other near shore communities
  - Aquatic invasive species in the estuary and other coastal wetlands have become a major concern within the scientific and management fields.
- Included in this work is an examination of the impacts of controlling invasive

- species on non-target communities
- The role of the estuary in mitigating pollution in Lake Erie
- The role of the estuary and other coastal wetlands in serving as refugia for native species populations impacted by invasive species on Lake Erie and in tributary streams

The action plan on the following pages describes research projects and products to be developed, continued, and coordinated by OWC NERR. The Reserve will operate cooperatively with other agencies and organizations in the region to achieve the goals, objectives, and actions outlined herein. Over the next five years, the Reserve will continue to monitor the estuary, both through the NERRS System-wide Monitoring Program, and through its own site-based program, to evaluate the impacts of management and stewardship practices on the estuary, and develop a greater understanding about the value of coastal wetlands in mitigating climate variability and protecting vulnerable native and migrating species.



Lake Erie sunrise from the OWC barrier beach.



VISION: OWC NERR is a regional leader in the stewardship and conservation of a Great Lakes coastal wetland ecosystem			
Mission: Improving the understanding, stewardship, and appreciation of Great Lakes estuaries and coastal wetland ecosystems			
GOAL	OBJECTIVES	ACTIONS	PROGRAM AREAS
<b>Improve scientific understanding of the estuary, watershed, and Lake Erie</b>	Reserve ecological conditions are monitored and indicators are developed to serve as a foundation for management-oriented research and for estuarine education	Continue to implement the NERR system-wide monitoring program	R
		Continue to build OWC NERR site-specific monitoring database relating to water quality	R
		Develop partnerships to complete taxonomic atlas of Old Woman Creek plants and animals	R
	5,000 K-12 and post-secondary students and educators learn about coastal wetland ecology	Support K-university and educator curriculum development and delivery integrating estuarine science	E, R
<b>Foster connections to the Old Woman Creek estuary and other coastal ecosystems</b>	Students are attracted to coastal resource management professions	Inform research questions that can be examined through service learning and internship	R, S
	The Reserve's learning environment and the experiences of visitors and users are enhanced	Advise on how estuarine science can be integrated in exhibits and display	E, R, S
		Inform facility planning by projecting future research space needs	A, R
	Volunteer service on behalf of the Reserve increases	Engage the OWC NERR Advisory Council in administrative aspects of the research program (e.g., proposal development/review)	R, S
		Work with volunteers who support Reserve research and establish protocols for monitoring watershed stewardship projects	A, E, R, S
<b>Inform decisions of Lake Erie communities and individuals regarding coastal ecosystems</b>	Reserve science and technical expertise is transferred to estuarine stakeholders	Coordinate the production of technical bulletins about coastal wetland ecology and wetland values to the Lake Erie ecosystem	E, R
		Provide information that will reduce impacts to wetland dependent avian species from wind energy	R
		Provide advisory service to coastal research organizations and programs	A, E, R, S
<b>Enhance the OWC NERR's role as a regional focal point for wetland stewardship science, practice implementation, and education</b>	Reserve ecological conditions are monitored and indicators are developed to serve as a foundation for management-oriented research and estuarine education	Monitor the impact of invasive species control on the estuarine food web	R, S
		Investigate the estuary's role in protecting threatened native species on Lake Erie and its tributaries	R
	Reserve science and technical expertise is transferred to estuarine stakeholders	Investigate technology for monitoring non-point source pollutants	R
		Develop monitoring framework that allows the Reserve to serve as a sentinel of climate change	R
		Investigate the effectiveness of management practices on water quality	E, R, S
<b>Maintain effective and professional program operations</b>	A networked organization with sufficient capacity to meet program goals and objectives	Develop new research partnerships	A, R

Program Area Key:  
 A - Administration  
 E - Education  
 R - Research  
 S - Stewardship

## **Guidelines and Policies for OWC NERR Research**

To fulfill the NERR System goals, as identified in the NERRS *Strategic Plan 2011-2016* and the NERRS *Research and Monitoring Plan 2006-2011*, research at OWC NERR addresses coastal management issues that have been identified as significant: promote Federal, state, public and private research activities within the individual reserves; conduct and participate in the coordination of estuarine research within the System, and gather and makes available information necessary for improved understanding and management of estuarine areas.

Research undertaken at OWC NERR is classified into two groups: 1) studies conducted under NERR or ODNR auspices and 2) other studies. The first group of studies is highly focused on specific research needs of OWC NERR and/or the ODNR-Division of Wildlife. The second category of studies may be less focused on these specific research priorities, but still very relevant to understanding the freshwater estuarine ecosystem. Permits are required for research and for scientific collection at OWC NERR.

Success of this research program depends upon the ability of the reserve staff to encourage the research community to utilize this site for studies. This is accomplished by providing the scientific community with: 1) guidelines for OWC research needs, 2) relevant data necessary to develop the identified research, 3) opportunity to conduct research in a limited access area, and 4) on-site laboratory and living facilities. The cumulative results of these diverse projects will be synthesized to form the body of information necessary to develop a comprehensive understanding of this freshwater estuarine system. In soliciting research from outside entities, flexibility in project design is critical. The final research study design will reflect both the needs of OWC NERR and the expertise of the researcher.

Research by independent or by reserve staff scientists may be conducted in the Reserve on topics consistent with the NERRS and OWC NERR site goals, and may be funded from numerous sources. In practice, many of the research topics investigated are typically those which have been prioritized by NOAA because these priorities and the priorities of other coastal funding sources reflect the needs of coastal zone decision makers.

## **Research Project Proposals**

The Reserve Research Coordinator, in conjunction with the Reserve Manager, will help the researcher develop a project that is compatible with ODNR policies and guidelines. All research proposals submitted will be evaluated by the OWC NERR Research Coordinator and Manager, often in conjunction with the OWC NERR Advisory Council, and other appropriate ODNR, including Wildlife staff, to ensure that the proposed research is compatible with research goals of OWC and ODW. After final approval, arrangements are made for initiating the research. For projects that may involve threatened or endangered plant species, a plant collecting permit is required from ODNR. Depending on the research proposed, a Scientific Collectors

Permit may be required from ODW. Contact Reserve staff for assistance in initiating a permit application.

### **Research Permitting Requirements**

Potential researchers must contact the OWC Research Coordinator prior to submitting a proposal. The Research Coordinator can provide insight on unique conditions at the site that may entail modifications in the proposed sampling techniques, as well as alert the researcher to appropriate current and previous studies conducted on-site that relate to the proposal. For example, the presence of nesting bald eagles has caused some access restrictions.

Large-scale manipulative research projects are strongly discouraged because such projects could seriously impact the natural integrity of the site. However, manipulative research projects that do not significantly alter the estuarine system may be acceptable. Such projects will be examined on a case by case basis by the OWC Reserve staff, other ODW staff, and the OWC NERR Advisory Council. The benefits of the research will be weighed against the short- and long-term perturbations caused by the research when each project is evaluated.

OWC NERR insists that researchers and Graduate Research Fellows provide the Research Coordinator with a copy of the final report, abstract, and any journal publication resulting from the research done at OWC. This is important for establishing a reference library of historical research and data at the reserve that can support future research projects and national efforts. After completion of the research, the OWC staff through the Research Coordinator will request that the principal investigator develop and/or deliver a presentation (poster, seminar or technical bulletin) that communicates the significant findings of the research to the appropriate public and management communities. These presentations will help the reserve achieve its objective of providing information for improved understanding and management of estuarine systems to both coastal decision makers and to the public.

### **Research Coordination**

Cooperative arrangements, formal and informal, may be established where appropriate for addressing joint research and/or common concerns. To prevent duplication of research, an effort is made to coordinate research initiatives proposed at OWC with other research activities conducted in the Ohio coastal and near-shore zones of Lake Erie. Within this coastal zone, major funding agencies include Ohio Coastal Zone Management Program, Ohio Sea Grant, and the Lake Erie Commission in support of the Lake Erie Protection and Restoration Plan.

### **Research Funding**

In addition to the national funding priorities (GRF, NERRS Science Collaborative), NOAA recognizes that individual reserves may adopt distinct approaches to issues such as baseline field studies, analysis of transport processes, theoretical systems modeling, and retrospective assessment of human impacts and alterations.

Proposals that address either the impact of changing lake levels or exotic species on the estuary will be especially welcomed. Currently, the impact of changing lake levels on the estuarine communities is a priority topic. In conjunction with this water level decline, the estuary has been greatly impacted by the invasion of aggressive, non-native plants, particularly the exotic strain of *Phragmites australis*. The impacts of control efforts on non-target communities is one that must be addressed if ecologically sound management practices are to be implemented for the control of this exotic plant. Studies that increase understanding of estuarine processes leading to pollutant breakdown are encouraged. Studies that use the Reserve as comparison for regional restoration efforts are consistent with the designation of the site as a representative lower Great Lakes freshwater estuary are highly valued.

OWC NERR is not always in a financial position to offer direct research funding. However, OWC NERR is often able to provide matching funds via in-kind services by reserve staff and use of on-site equipment by researchers. Researchers using OWC as a research site have also been very successful in obtaining outside research money. NOAA has funded several joint projects NOAA/Ohio Sea Grant projects, and ERD has funded several competitive research and monitoring projects.

Other funding sources in recent years:

- NSF
- USDA
- USEPA
- USEPA/USFWS
- USFWS
- ODNR (e.g., Coastal management program)
- Ohio Lake Erie Protection Fund

## Great Lakes Restoration

The 2010 Federal budget provided \$475 million for a new Environmental Protection Agency-led, interagency Great Lakes Restoration Initiative, which will target the most significant problems in the region, including invasive aquatic species, non-point source pollution, and contaminated sediment.

This initiative will use outcome-oriented performance goals and measures to target the most significant problems and track progress in addressing them. EPA and its Federal partners will coordinate State, tribal, local, and industry actions to protect, maintain, and restore the chemical, biological, and physical integrity of the Great Lakes.

The Reserve will engage partners in regional coastal wetland monitoring proposals. Important questions that can influence coastal wetland restoration include developing a greater understanding of how coastal wetlands serve as refugia for native species impacted on Lake Erie and its tributaries.

## Research Completed at OWC NERR

A list of publications related to all research completed at OWC NERR through 2008, as well as a list of OWC Technical Reports and Bulletins, may be found in Appendices 6 and 7. A current list of research publications and current research projects are available through the Reserve. The site profile, The Ecology of Old Woman Creek, Ohio: An Estuarine and Watershed Profile, was completed in 2004 and revised in 2006.

## Facilities and Equipment

The laboratories at OWC were planned and additions made to incorporate a variety of specialized facilities required for modern ecological research, while providing the flexibility necessary to accommodate future potential research requirements.

- Analytical chemistry laboratory for general nutrient and metals chemistry
- Low level radioisotope laboratory
- Microscope/balance room
- Laboratory equipped for microbiological work
- General laboratory area providing flexibility for accommodating future research requirements
- Permanent monitoring equipment installed at selected sites in the estuary to allow researchers to quantify flow rates and determine chemical loads into and out of the estuary
- Small reference library in the Visitor/Research Center houses regional studies, with relevant taxonomic works and general references.

The success of the research program will depend upon both the interest of prospective researchers and the availability of the equipment and facilities that are required to undertake the projects. The increasing complexity of research requires ever-more specialized facilities and sophisticated equipment. Every effort will be made to accommodate future research facility and equipment needs within the constraints of the NERRS program and Ohio Division of Wildlife. A recent facility needs study has recommended that laboratory facilities be enlarged to meet the expanding outside research interest in the reserve.

## Monitoring Plan for OWC NERR

Monitoring (the systematic collection of environmental data) at OWC NERR is based on the premise that physical, chemical, and biological aspects of habitats and communities of organisms are excellent indicators of the effects of a vast array of environmental factors. Chronic environmental disturbances are expressed through changes in habitat quality, species composition, population abundance, distribution, growth, and mortality rates. An understanding of baseline conditions and subsequent monitoring data will provide an early warning of changes in estuarine and upland resources, which in turn will alert management to potential stewardship issues. Monitoring also allows scientists to develop new research priorities, measure the success of restoration efforts, and contribute to the NERR System overview of trends in estuarine processes. Accordingly, OWC NERR monitors

critical habitat parameters and the dynamics of selected communities to gain insights into ecosystem health.

The monitoring plan for OWC NERR is modeled on the strategic plan developed for the NERR System. One function is to provide benchmark information to researchers, as well as to coastal community and coastal resource managers. Through routinely monitoring conditions in this natural wetland, benchmark conditions are established against which human-induced changes in other coastal wetlands can be measured.

The OWC NERR monitoring program strives to detect, quantify, and predict both short- and long-term changes in the health and viability of estuarine ecosystems. Monitoring data also provides the research community with background information needed to develop future research initiatives. To this end, biological, chemical, physical, and community conditions of the Reserve are characterized and monitored to describe reference conditions and then to quantify change.

It is the policy of OWC NERR to follow the Phased Monitoring Plan initiated by NOAA in 1989, and as outlined in the NERRS Regulations and Strategic Plan:

- Phase I:** Environmental Characterization, including studies necessary for inventory and comprehensive site descriptions; initiate System-wide Monitoring Program;
- Phase II:** Site Profile, to include a synthesis of data and information; and
- Phase III:** Implementation of a systematic long-term monitoring program to focus on selected parameters.

## **NERR System-wide Monitoring Program (SWMP)**

The System-wide Monitoring Program provides standardized data on national estuarine environmental trends while allowing the flexibility to assess coastal management issues of regional or local concern. The principal mission of the monitoring program is to develop quantitative measurements of short-term variability and long-term changes in the integrity and biodiversity of representative estuarine ecosystems and coastal watersheds for the purposes of contributing to effective coastal zone management. The program is designed to enhance the value and vision of the reserves as a system of national references sites. The program also takes a phased approach and focuses on three different ecosystem characteristics.

### **Abiotic Variables**

The monitoring program currently measures pH, conductivity, salinity, temperature, dissolved oxygen, turbidity, water level and atmospheric conditions. In addition, the program collects monthly nutrient and chlorophyll a samples and monthly diel samples at one SWMP data logger station. Each reserve uses a set of automated instruments and weather stations to collect these data for submission to a centralized data management office.

### **Biotic Variables**

The reserve system is focusing on monitoring biodiversity, habitat and population characteristics by monitoring organisms and habitats as funds are available.

### **Watershed and Land Use Classifications**

This component attempts to identify changes in coastal ecological conditions with the goal of tracking and evaluating changes in coastal habitats and watershed land use/cover. The main objective of this element is to examine the links between watershed land use activities and coastal habitat quality.

These data are compiled electronically at a central data management hub, the Centralized Data Management Office (CDMO) at the Belle W. Baruch Institute for Marine Biology and Coastal Research of the University of South Carolina. They provide additional quality control for data and metadata and they compile and disseminate the data and summary statistics via the Web (<http://cdmo.baruch.sc.edu>) where researchers, coastal managers and educators readily access the information. The metadata meets the standards of the Federal Geographical Data Committee.

OWC NERR has participated in SWMP since the program's inception in 1995. The locations of the four SWMP sites and the DeWine Center weather station are shown on Figure 8.

### **OWC NERR as Sentinel Site**

Climate variability has been the largest change agent in Great Lakes coastal wetland ecology. Short term shifts have impacted lake levels, which have had a cascading effect on wetland emergent vegetation and sediment movement. Since lake level data began to be recorded in the 1800s, coastal wetlands in the Great Lakes have been through several iterations of climate variability.

The protected status of the Reserve, and its long-term monitoring capability and datasets, make the site an ideal sentinel of longer term climate change brought on by greenhouse gas emissions. OWC NERR has been monitoring water quality and weather conditions since the mid-Nineties through the SWMP. The Reserve will take additional steps to serve as an early indicator of climate impacts on Great Lakes coastal wetlands and near shore habitats:

- by creating several survey witness posts within the lower estuary and swamp forest,
- by periodically monitoring sediment deposition using the highly accurate points,
- by conducting periodic emergent vegetation mapping,
- by partnering to secure a lake monitoring platform in the central basin of Lake Erie, and,
- by monitoring bathymetric change in the estuary.

A detailed bathymetric map of the estuary was prepared by Drs. Herdendorf and Hume (1991). (Figure 7) Selected data points on the map will be checked at 10 to 20 year intervals to monitor sedimentation and erosion changes in the estuary.

### **OWC NERR Site-based Monitoring Priorities**

The monitoring program at OWC NERR was initiated to develop a databank of basic information about the estuary, its watershed, and the adjacent near shore portions of Lake Erie. The program is designed to allow detection of subtle long-term changes in OWC and its watershed as well as to provide potential researchers with information critical in developing future research projects.

### **Aquatic Vegetation**

The OWC NERR site profile, *The Ecology of Old Woman Creek, Ohio: An Estuarine and Watershed Profile* was published in 2004. In wetland areas, such as the OWC estuary, the aquatic vegetation forms the foundation of the estuarine food web. Therefore, any changes in this community have major ramifications throughout the estuary. Previous studies, highlighted in the site profile, have demonstrated the need to periodically monitor the aquatic vegetation in the estuary because of constantly changing Lake Erie water levels. Aquatic vegetation monitoring is also an important climate change indicator.

### **Other Biological Communities**

Species lists and basic seasonal patterns for other communities in the estuary have been developed by researchers in the course of their studies. (See App. 8) Periodic sampling of these communities will be incorporated into the OWC NERR monitoring program as resources permit.

### **Chemical Components**

With the inception of the OWC NERR in 1980, a program to monitor chemical components of the estuarine and upstream waters of OWC was initiated. The chemical and physical parameters currently being monitored include nutrients, as well as many of the basic components of the waters. Although this chemical monitoring program was modified to address specific questions of interest in different parts of the estuary, several sites have been continually monitored since the inception of the program. These benchmark locations include a site in the creek proper (datalogger site BR), a site in the upper reaches of the estuary (datalogger site DR), a site at the mouth (datalogger site WM), and a site in the surf zone of Lake Erie.

In conjunction with this chemical monitoring program—when funding and equipment are available—water level data is collected at representative water gages in the lower reaches of both the creek and the estuary to quantify water movement into and out of the estuary. One gage is maintained by the U.S. Geological Survey (USGS); the other, by OWC NERR staff.



Figure 7. OWC NERR Bathymetric Map

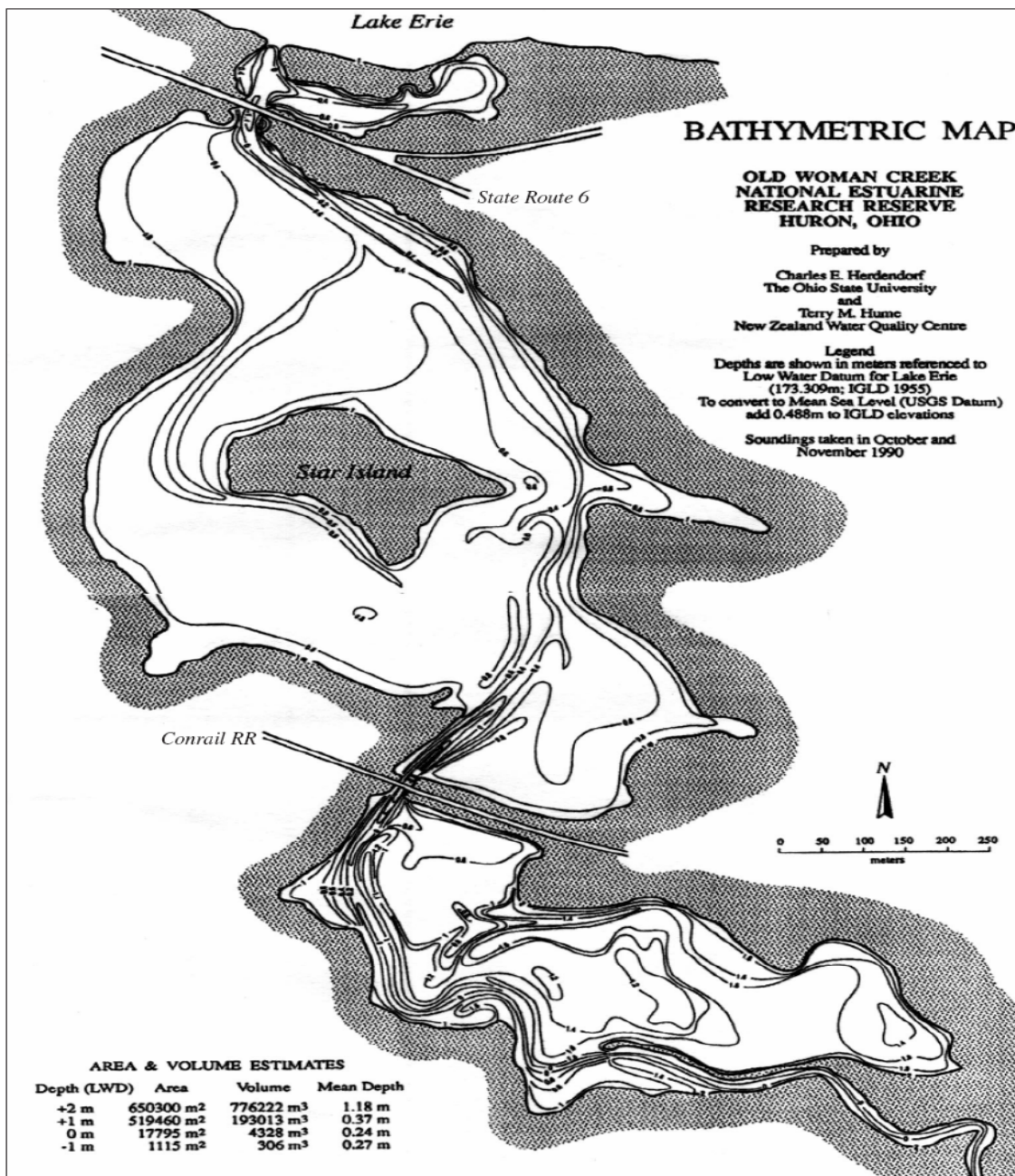
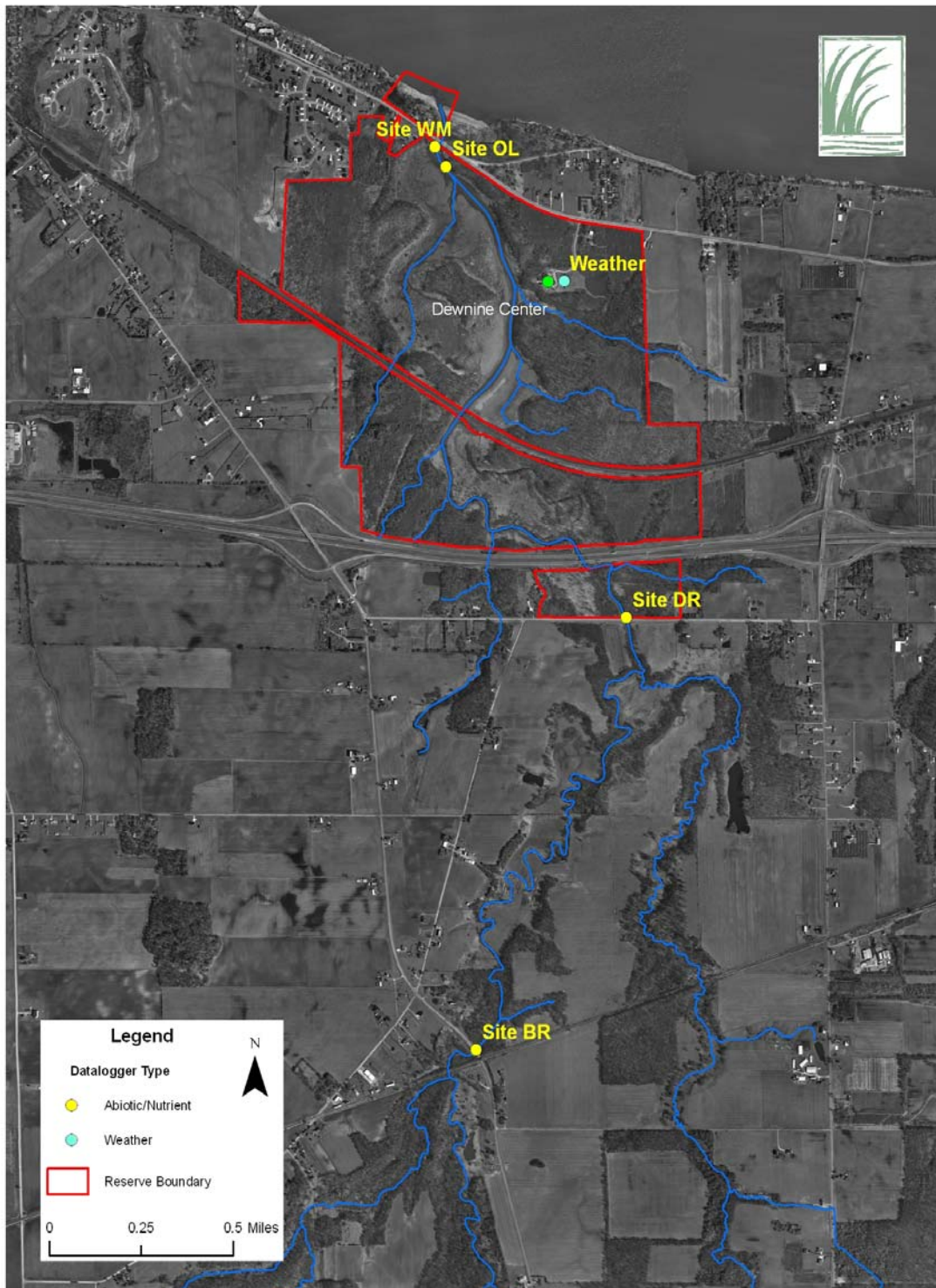


Figure 8. OWC NERR System-wide Monitoring Stations



## Chapter 4. Education, Training, and Outreach Plan

The reserve system provides a vehicle to increase understanding and awareness of estuarine systems and improve decision-making among key audiences to promote stewardship of the nation's coastal resources. Education and interpretation in the reserves incorporates a range of programs and methodologies that are systematically tailored to key audiences around priority coastal resource issues and incorporate science-based content. Reserve staff members work with local communities and regional groups to address coastal resource management issues, such as non-point source pollution, habitat restoration and invasive species. Through integrated research and education programs, the reserves help communities develop strategies to deal successfully with these coastal resource issues.

Formal and non-formal education and training programs in the NERRS target K-12 students, teachers, university and college students and faculty, as well as coastal decision-maker audiences such as environmental groups, professionals involved in coastal resource management, municipal and county zoning boards, planners, elected officials, landscapers, eco-tour operators and professional associations.

K-12 and professional development programs for teachers include the use of established coastal and estuarine science curricula aligned with state and national science education standards and frequently involves both on-site and in-school follow-up activity. Reserve education activities are guided by national plans that identify goals, priorities, and implementation strategies for these programs. Education and training programs, interpretive exhibits and community outreach programs integrate elements of NERRS science, research and monitoring activities and ensure a systematic, multi-faceted, and locally focused approach to fostering stewardship.

### Reserve System Education Goals

The National Estuarine Research Reserve System's mission includes an emphasis on education, interpretation, and outreach. Education policy at OWC NERR is designed to fulfill the reserve system goals as defined in the regulations (15 C.F.R Part 921(b)). Education goals include:

- Enhance public awareness and understanding of estuarine areas and provide suitable opportunities for public education and interpretation;
- Conduct and coordinate estuarine research within the system, gathering and making available information necessary for improved understanding and management of estuarine areas.

## **Reserve System Education Objectives**

Education-related objectives in the Reserve System Strategic Plan 2011-2016 included:

- Enhance the capacity and skills of teachers and students to understand and use NERRS data and information for inquiry-based learning.
- Increase estuary literacy and promote active stewardship among public audiences through the development and delivery of tools and programs addressing climate change, habitat protection, and water quality.
- Improve the capacity and skills of coastal decision-makers to use and apply science-based information in decisions that affect estuaries and coastal watersheds.

## **Reserve System Coastal Training Program**

The Coastal Training Program (CTP) provides up-to-date scientific information and skill-building opportunities to coastal decision-makers who are responsible for making decisions that affect coastal resources. Through this program, National Estuarine Research Reserves can ensure that coastal decision-makers have the knowledge and tools they need to address critical resource management issues of concern to local communities.

Coastal Training Programs offered by reserves relate to coastal habitat conservation and restoration, biodiversity, water quality and sustainable resource management and integrate reserve-based research, monitoring and stewardship activities. Programs target a range of audiences, such as land-use planners, elected officials, regulators, land developers, community groups, environmental non-profits, business and applied scientific groups. These training programs provide opportunities for professionals to network across disciplines, and develop new collaborative relationships to solve complex environmental problems. Additionally, the CTP provides a critical feedback loop to ensure that professional audiences inform local and regional science and research agendas. Programs are developed in a variety of formats ranging from seminars, hands-on skill training, participatory workshops, lectures, and technology demonstrations. Participants benefit from opportunities to share experiences and network in a multidisciplinary setting, often with a reserve-based field activity.

Partnerships are important to the success of the program. Reserves work closely with State Coastal Programs, Sea Grant College extension and education staff, and a host of local partners in determining key coastal resource issues to address, as well as the identification of target audiences. Partnerships with local agencies and organizations are critical in the exchange and sharing of expertise and resources to deliver relevant and accessible training programs that meet the needs of specific groups.

The Coastal Training Program requires a systematic program development process, involving periodic review of the reserve niche in the training provider market, audience assessments, development of a three to five year program strategy, a marketing plan and the establishment of an advisory group for guidance, program review and perspective in program development. The Coastal Training Program

implements a performance monitoring system, wherein staff report data in operations progress reports according to a suite of performance indicators related to increases in participant understanding, applications of learning and enhanced networking with peers and experts to inform programs.

## **Education Plan of OWC NERR**

The action plan on the following pages describes education programs and products to be developed and coordinated by OWC NERR. The Reserve will operate cooperatively with other agencies and organizations in the region to achieve the goals, objectives, and actions outlined herein. During the next five years, the Reserve will begin implementing the NERRS K12 Estuarine Education Program (KEEP), move into the second phase of implementation for the Ohio Coastal Training Program, and continue to develop specialized environmental education programs focused on the OWC estuary and other Great Lakes coastal ecosystems.

<b>VISION: OWC NERR is a regional leader in the stewardship and conservation of a Great Lakes estuarine ecosystem</b>				
<b>Mission: Improving the understanding, stewardship, and appreciation of Great Lakes estuaries and coastal wetland ecosystems</b>				
GOAL	OBJECTIVES	ACTIONS	PROGRAM AREAS	NOAA EDUCATION PLAN Goal.Outcome.Strategy
<b>Improve scientific understanding of the estuary, watershed, and Lake Erie</b>	Reserve ecological conditions are monitored and indicators are developed to serve as a foundation for management-oriented research and for estuarine education	Develop education products and programs that translate OWC NERR research and monitoring data and engage students and citizens in the research process	E,R	1.3.2
		5,000 K-12 and post-secondary students and educators learn about coastal wetland ecology	Plan and implement a site-based K-12 Estuarine Education Program (KEEP)	E,R,S
	Correlate NERRS and Old Woman Creek curricula to Ohio Academic Content Standards		E	1.3
	Contribute to Great Lakes and freshwater information to NERRS education initiatives		E	1.3.2
	Adapt and incorporate Environmental Literacy principles and concepts into curriculum and products		E, S	1.2 and 1.5
	Train educators to use NERRS and other environmental education tools to further student's understanding of estuarine science		E, R	1.3
	Provide field based estuarine science education to students, preK-university level, targeting specific grades on needs assessment results and recommendations from Education Advisory Committee	E, R	1.4.4	

Program Area Key:  
 A - Administration  
 E - Education  
 R - Research  
 S - Stewardship

VISION: OWC NERR is a regional leader in the stewardship and conservation of a Great Lakes estuarine ecosystem				
Mission: Improving the understanding, stewardship, and appreciation of Great Lakes estuaries and coastal wetland ecosystems				
GOAL	OBJECTIVES	ACTIONS	PROGRAM AREAS	NOAA EDUCATION PLAN Goal.Outcome.Strategy
<b>Foster connections to the Old Woman Creek estuary and other coastal ecosystems</b>	Students are attracted to coastal resource management professions	Provide students hands-on opportunities to develop skills needed for coastal resource education careers	A,E,R,S	2.3.2
		Develop web-based information regarding coastal resource management career opportunities	E	2.2.2
	The Reserve's learning environment and the experiences of visitors and users are enhanced	Design and offer community education programs at the Reserve and local community sites	E	1.1.1, 1.4.4
		Complete renovation of interpretive displays consistent with developed concepts	A,E,R,S	1.3.2
		Provide an outdoor experience that completes visitor understanding of estuarine ecology, stewardship, and the NERRS	E	1.4.4
		Inform facility planning by projecting for future education space needs	A, E	1.4.4
	Volunteer service on behalf of the Reserve increases	Engage the OWC NERR Advisory Council in planning education activities	A, E, R, S	1.6.4
		Recruit partners and skilled volunteers to advise the Reserve on education program development and assist with program delivery, especially during visitor center public hours	A, E	1.4.3

Program Area Key:  
 A - Administration  
 E - Education  
 R - Research  
 S - Stewardship

VISION: OWC NERR is a regional leader in the stewardship and conservation of a Great Lakes estuarine ecosystem				
Mission: Improving the understanding, stewardship, and appreciation of Great Lakes estuaries and coastal wetland ecosystems				
GOAL	OBJECTIVES	ACTIONS	PROGRAM AREAS	NOAA EDUCATION PLAN Goal.Outcome.Strategy
<b>Inform decisions of Lake Erie communities and individuals regarding coastal ecosystems</b>	50 citizens adopt or install stewardship practices because of Reserve education programs/Sediment and nutrient loading into the estuary is reduced by 25%	Offer programs and demonstration projects that increase citizen and landowner ability to minimize degradation of water quality and wildlife habitat	E, S	1.4.2 and 1.4.4
	3,000 coastal decision-makers receive science based training and information that supports coastal stewardship	Implement Ohio CTP strategy based on identified training needs among Lake Erie basin local government officials	E	1.1.1
<b>Enhance the OWC NERR's role as a regional focal point for wetland stewardship science, practice implementation, and education</b>	Reserve science and technical expertise is transferred to estuarine stakeholders	Inform students and the public about the ecological and economic impacts of invasive species and increase knowledge about control methods and prevention of new introductions	E, S	1.4.4
<b>Maintain effective and professional program operations</b>	The effectiveness of Reserve education programs are measured by needs assessment and evaluation strategies	Use community based social marketing as a program design tool to address barriers and increase the probability that programs influence behavior.	E	1.1.1
	A networked organization with sufficient capacity to meet program goals and objectives	Upgrade education program facilities, technological capabilities, and program marketing	A, E	1.1, 1.4, 1.6
		Build education staff capacity, volunteer support, and program delivery efficiency	A,E	1.6.2
		Create partnerships to provide travel support for Reserve users that enables them to overcome financial obstacles	A, E	1.6.2

Program Area Key:  
 A - Administration  
 E - Education  
 R - Research  
 S - Stewardship



## OWC NERR Education Program Descriptions

OWC NERR offers Lake Erie's coastal residents and visitors unparalleled opportunities to learn about estuaries and other Lake Erie coastal ecosystems. Reserve education programs are designed to increase awareness and understanding of estuaries and foster natural resource stewardship.

The Reserve serves as a classroom for instruction in the natural sciences. Science-based, experiential programs are custom designed for students and educators K-20, civic organizations, local decision-makers, and other professionals throughout the Lake Erie watershed. Guided hikes, canoe tours, and stewardship workshops are regularly offered to community members. Particular emphasis is placed on the timely interpretation of scientific information for specific target audiences.

### K-12 Education

OWC NERR offers graduate credit-bearing Professional Teacher Development (PTD) workshops focus on use of estuarine, coastal wetland, and Great Lakes research and data in the classroom. Workshops are offered in collaboration with other agencies such as Center for Ocean Science Excellence in Education (Great Lakes) and Ohio State University Sea Grant College Program – Stone Laboratory and feature instruction by the OWC NERR Research Coordinator, Graduate Research Fellows, Ohio State University faculty, and visiting scientists. In addition, OWC NERR offers PTD for several other national education curricula focused on aquatic ecosystems and natural resources including Project WET, Science and Civics, Healthy Water/Healthy People, Wonders of Wetlands, Project WILD and Aquatic WILD. The Reserve promotes and facilitates involvement in *Estuary Live* by classrooms across northern Ohio and trains teachers to use of *Estuaries 101*.



Topical focuses of K-12 education programs include biodiversity, water quality, non-point source pollution, coastal processes, functions and values of wetlands, watershed management, stormwater, climate change, wildlife monitoring, and green building. The Reserve will seek to develop additional educational programs in high priority coastal management and stewardship issue areas such as invasive species, wastewater treatment, and watershed development. The Reserve will use its own research and monitoring information (e.g., SWMP data) in the development of program and lessons.



Programs range from 2 hour guided trail walks to 6 hour or more (sometimes overnight) intensive field experiences for high school students. Field experiences include any or all of the following activities depending on age and program length: seining for aquatic invertebrates and small vertebrates, plankton sampling, canoeing, use of laboratory equipment for exploration of samples including dichotomous keys, and microscopes.

The Reserve focuses on high school students and markets events to the appropriate local and regional educators. In addition, the Reserve provides in-classroom instruction and distance learning programs on estuarine and wetland ecology and wildlife diversity.

Within the next five years, OWC NERR will undertake implementation of the NERRS KEEP consistent with the program initiation protocol outlined in the 2008 KEEP Framework. The Reserve will begin its KEEP implementation by establishing an education advisory committee with representation from key stakeholders in estuarine and watershed education in the region:

#### Regional Entities:

- Centers for Ocean Science Excellence in Education – Great Lakes
- Science Education for New Civic Engagement and Responsibilities (SENCER) - Great Lakes Regional Innovation Center
- Science Education Council of Ohio (Ohio Chapter of National Science Teachers Association)
- Great Lakes Educators of Aquatic and Marine Science (Regional Chapter of National Marine Educators Association)
- University of California Lawrence Hall of Science – Full Option Science System (Ohio affiliate)
- NOAA Great Lakes Environmental Research Laboratory
- Great Lakes Science Center
- Cleveland Museum of Natural History – Green City Blue Lake Institute
- National Weather Service Cleveland Forecast Office

#### State Entities:

- Ohio Department of Education (Office of Curriculum & Instruction)
- ODNR Division of Wildlife – Education Coordinator
- Ohio Lake Erie Commission
- ODNR Office of Coastal Management
- Ohio Sea Grant College Program
- Ohio Environmental Council
- Environmental Education Council of Ohio
- Ohio Environmental Protection Agency

#### Local Entities (Agencies, NGOs, and academic institutions)

- Watershed Program - Firelands Coastal Tributaries Watershed Program
- Friends of OWC
- School District (Berlin-Milan, Norwalk, Huron, Sandusky, Lorain, Western Reserve, Cleveland)
- Soil and Water Conservation District (Erie or Huron County)
- Park District (Erie, Lorain, Toledo, Cleveland Metroparks)
- Solid Waste Management District
- Ashland University Schar College of Education
- Oberlin College

The Reserve will work with the newly formed Education Advisory Committee to conduct a market analysis and needs assessment to characterize K-12 estuarine and coastal wetland education services and needs throughout the lower Great Lakes region. Based upon the outcome of this analysis, the Reserve will identify its niche for KEEP implementation, including target audiences (students versus teachers and grade level, geographic scope, and program delivery methods).

The Reserve will develop a KEEP implementation strategy based on market analysis and needs assessment results in consultation with the advisory committee and key program partners. The strategy will be consistent with the goals and objectives of OWC NERR, NERRS, and ODW, and will define a programmatic and target audience focus for K12 education at OWC NERR. The plan will include a logic model, evaluation methods, describe key partnerships, staffing, infrastructure, and resource needs, and outline an approach for integrating Reserve research and monitoring. Upon adoption of this plan, the education coordinator will begin designing a suite of programs based on principles of estuarine, climate, ocean, and Lake Erie literacy. All K-12 programs developed and offered by OWC NERR will be aligned to Ohio academic content standards.

After this foundational work, OWC NERR will apply for KEEP funds available through the NERRS. In lieu of availability of NERRS funds, the Reserve will seek alternate mechanisms to fund implementation of a site-based KEEP. Potential funding sources include the NOAA Office of Education, the Ohio Environmental Protection Agency – Ohio Environmental Education Fund, other state and federal agencies and private foundations.

## **Post-Secondary Education**

OWC offers university and community college level classes to expand understanding of coastal estuaries among post-secondary students. The Reserve hosts and provides field-based estuarine education for undergraduate students in a range of disciplines from basic science courses for non-majors to upper level courses in biogeochemistry and systems ecology, often through its partnership with Ohio State University's Stone Laboratory. Partnerships in entry level classes are forged and provide a future base for recruiting new researchers back to our facility in the future. Intensive educational experiences are afforded to undergraduate and graduate students through summer internships, fellowships, and service learning projects at OWC NERR.

Consistent with outcomes related to the NOAA education workforce development goal, OWC NERR will expand its efforts to connect students to professional opportunities related to NOAA's mission through internships, fellowships, and service learning programs. A key partnership to be engaged as part of this effort will be the Great Lakes Innovative Stewardship through Education Network (GLISTEN). GLISTEN is a three-year initiative of the National Center for Science and Civic Engagement that will harness the expertise and innovation of college faculty and undergraduate students to promote stewardship of the Great Lakes, an ecosystem containing 20% of the world's fresh water. In particular, the Reserve will reach out to Cleveland/Akron and Toledo based clusters where Great-Lakes-stewardship-

focused courses will be developed and offered over the next three years. GLISTEN Clusters include 4 and 2 year universities and colleges, community-based organizations, local governments and others as collaborators working to achieve goals for water quality, clean air, conservation, and other environmental improvement. Each cluster also includes representatives from at least one informal science education venue, such as a science museum, nature center or state or national park. Stewardship Liaisons will be students from GLISTEN courses who will work with community partners to implement Cluster goals. If future GLISTEN grant opportunities arise, the Reserve will work as a formal partner with northern Ohio clusters.

## Community Education

The Reserve collaborated with the NOAA Coastal Services Center to evaluate the social context of the OWC estuary through census data analysis and conduct of interviews and focus groups with watershed residents. Recommendations from this study included that the Reserve foster development of a watershed association to empower local people to address pollution issues in the OWC watershed. Subsequent to this project, the Reserve facilitated a collaborative process among local non-profits and agencies to obtain funding and institute a watershed program.



A survey assessing perspectives, knowledge, and interest in participating in watershed education and stewardship among residents indicated a relatively developed understanding of watersheds and interest in protecting local water quality. 75% of survey respondents indicated they were interested in receiving a local newsletter about OWC .

The Reserve now funds and edits a quarterly newsletter produced by the local watershed program. Nearly half of respondents were interested in attending meetings about the creek, more than a third in a workshop about evaluating water quality and a quarter in workshops about environmentally friendly lawn care and landscaping, and septic system maintenance. Local universities and agencies are engaged to provide training, technical assistance, and equipment for a team of volunteers that monitor water quality in OWC and neighboring watersheds. In addition, a community education program series, entitled *Estuary Explorations*, provides participants diverse opportunities to learn about the ecology of the estuary and gain watershed wetland stewardship skills. Guided hikes and canoe tours focus on flora and fauna identification and translation of Reserve research. Hands-on workshops involve participants in stream and beach clean-ups and construction of stormwater practices applicable for home landscape (e.g. rain gardens). Nature art and photography classes offer the chance to connect with the estuary environment through a creative process. Research demonstrations feature conversations with scientists studying vegetation patterns, invasive species, and the capacity of coastal wetlands to remove and transform pollutants.

OWC NERR will continue to develop and expand community education programs based on needs assessments and market analysis in concert with local partners such as the Firelands Coastal Tributary Watershed Program, Erie MetroParks, Erie and Huron Soil and Water Conservation Districts, Erie Solid Waste Management District, Friends of OWC, and the Firelands Audubon Society. Local community education will continue to be provided to the local public through *Estuary Explorations*. In addition, a Landowner Stewardship Series of quarterly talks will be added to work with local citizens driven to take stewardship action on their own properties. While Estuary Explorations entices the community to learn about new topics, the stewardship series will assist the public in building and installing new stewardship practices on their own properties.

## **Lake Erie Partnership**

In 2008 OWC NERR initiated a partnership for Lake Erie education and outreach with the Ohio Department of Natural Resources (ODNR) Office of Coastal Management, Ohio Sea Grant College Program and the Ohio Lake Erie Commission. The partnership is working to develop a unified strategic plan for Lake Erie education and outreach to achieve the vision of a Lake Erie literate citizenry that makes informed decisions and takes personal actions that create a healthier lake and watershed. The plan will identify how partnership members will coordinate and work collaboratively to achieve its vision and the goals and outcomes outlined in the NOAA Education Strategic Plan 2009-2029.

As part of this effort, the agencies identified a need for a place-based environmental literacy framework for Lake Erie. A project team initiated the development of this framework by adapting Ocean Literacy Concepts to Lake Erie (Appendix V). Comment has been invited from educators, resource managers and scientists throughout the Lake Erie watershed. Next steps for this project include incorporating input, aligning Lake Erie literacy principles and concepts to Ohio academic content standards, and using them as a framework developing curriculum and as a mechanism to bridge research and education. Coupled with estuarine and climate literacy, Lake Erie Literacy will inform the development of all OWC NERR education programs.

OWC NERR will continue to work with the Lake Erie Partnership to develop and implement a unified Lake Erie education and outreach plan and to finalize principles and concepts of Lake Erie and Great Lakes Literacy. Subsequently, the Reserve will work with Lake Erie Partnership, COSEE Great Lakes, and regional educators to develop concept flow diagrams that graphically illustrate science concepts underlying the Lake Erie Literacy Principles, developmental appropriateness, academic standards, how instructions of the concepts might flow and then to develop curriculum and education products founded upon principles of Lake Erie, estuarine and climate literacy. In 2010, the Reserve is co-leading a Lake Erie Partnership effort with WGTE Public Media to develop a set of video vignettes focusing on the eight Lake Erie Literacy Principles. These videos will 'humanize' current Lake Erie research by breaking down complicated science concepts into practical real-world applications that will inform viewers as to actions they can take to help protect and restore Lake Erie. When completed, the videos will be featured on

video kiosks at the OWC NERR visitor center, and will also be broadcast on local television and available for download via the web.

## Training



The mission of the Ohio Coastal Training Program (CTP) is to enhance stewardship of Lake Erie by providing science-based training and technical assistance to professionals, officials, and volunteers who make decisions that impact the Lake and its watershed. The Ohio CTP serves decision-makers in thirty-four counties across northern Ohio. Since its inception in 2004, the program has trained over 1,700 decision-makers and professionals on topics such as best practices for land use planning, stormwater management, grant writing, and oil spill response. It has provided technical assistance to

secure a four-year grant for community-based watershed planning and conducted studies to assess the training needs of local government officials.

Ohio CTP courses and products are targeted to specific roles and competency levels. Audience diversity is sought to maximize potential for interdisciplinary engagement and collaborative problem solving but is also balanced against the need to provide information and skill building opportunities applicable to the professional or decision-making roles of participants. To date, local and county officials have represented the majority of participants followed by businesses and non-profit organizations. Efforts have centered on enhancing the core partnership through communication and project-based collaboration, building external partnerships, and refining the Ohio CTP issue and audience focus.

The Ohio CTP leverages the scientific and resource management expertise of four core partners to provide and enhance training and technical assistance for Lake Erie watershed decision-makers. The program is administered by OWC NERR staff and guided by an Executive Committee consisting of representatives from OWC NERR, Ohio Department of Natural Resources Office of Coastal Management, Ohio Sea Grant College Program, and Ohio Lake Erie Commission. The Ohio CTP also collaborates and coordinates with a wide range of additional government, university, and non-profit partners.

The Ohio CTP contributes to the mission of OWC NERR and a number of its goals. The Reserve's primary goal involving the Ohio CTP is to inform decisions of Lake Erie communities and individuals regarding coastal ecosystems. The Ohio CTP supports these integrated Reserve goals and associated objectives:

- By providing science-based training and information regarding the value, ecology, and stewardship of Lake Erie.
- By facilitating connections between decision-makers and scientists, including transfer of research results and user engagement in the research process.
- Through increasing scientific understanding and skills among decision-makers and assisting them in implementing best practices to protect Lake Erie, its coast, and watershed.
- By hosting training events and/or field experiences at the Reserve.
- By using research-based practices to develop and implement decision-maker training programs and by coordinating the training efforts of Ohio NOAA programs, the Ohio Lake Erie Commission and other training providers in the Lake Erie basin.
- By working with Reserve research and stewardship sectors and others to implement and monitor land use and stormwater best practice demonstrations and providing training for decision-makers focused on the design and performance of these practices.

The strategic plan of the Ohio CTP was revised and approved by the NERRS Coastal Training Program Oversight Committee in 2009 (See Appendix J for complete plan). The plan outlines objectives and strategies the program will undertake to achieve its goal of informing decisions for the stewardship of Lake Erie and balanced growth in its watershed. Objectives focus on training and services to address the needs of local officials related to stormwater, watershed management and land use planning, Lake Erie shore erosion and climate change.

#### Outcomes (Strategic Plan 2009-2012, Appendix J)

##### Lake Erie watershed decision-makers:

- Possess the science-based knowledge and skills needed to make informed decisions.
- Are exposed to multi-disciplinary and organizational perspectives related to Lake Erie issues.
- Recognize the environmental, economic, and social value of Lake Erie.
- Understand the impact of their decisions on Lake Erie and its watershed.
- Take action to protect and restore Lake Erie and watershed ecosystems.
- Have their needs met by a coordinated and efficient training market in the Lake Erie watershed.
- Are supported by a scientific community that is aware of decision-maker information needs, conducts research to address them, and engages decision-makers in applied research related to Lake Erie resource management challenges.

## Outreach

A core outreach focus during this management period is design and construction of new visitor center exhibits.

In 2006, OWC NERR contracted an exhibit design/fabrication firm to develop a conceptual plan for new visitor center exhibits (See Appendix U for design concepts). An integrated team of Reserve staff consisting of the Education Specialist, CTP Coordinator, Manager, and Research Coordinator worked with the contractor to identify goals and develop concepts for four anchor exhibits.

### Exhibit Organizing Concepts:

- Explain how an estuary works
- Powerfully transmit the value of the estuary as a
  - means of filtering water supply
  - protection from floods and erosion
  - habitat for wildlife
  - source of data that can improve the management of coastal resources
- Create personal meaning by helping visitors to integrate what they see at the Reserve, develop an enhanced appreciation of the natural environment and foster a sense of stewardship that will lead to behavior change
- Provide background information on
  - History of the estuary and surrounding area
  - A basic understanding of the NERRS

Subsequent to the development of exhibit anchor concepts, the exhibit design/fabrication firm and OWC NERR engaged a visitor services research consultant to incorporate visitor feedback in the visitor center conceptual plan. In consultation with the design contractor and Reserve staff, this consultant conducted a visitor panel, an audience research process in which carefully selected groups of prospective visitors are treated as “consultants”—experts in the visitor experience.

The primary purpose of the study was to incorporate the panel’s feedback in the planning of exhibits for the renovated Visitor Center. A secondary purpose was to inform the Reserve’s internal team and Advisory Council members about public perspectives on visitor services.

The visitor panel was both a front-end and formative evaluation in the sense that panelists were asked to share their experience and interest in natural environments in general, as well as to comment on specific exhibits that are already being planned for the Visitor Center. Visitor panelist responses to the four anchor exhibits were very positive with some suggestions. The Reserve worked with the design firm to incorporate panelist suggestions into the design concepts.



Recommendations from the visitor service organization to the Reserve include the following:

- Make first impressions inviting and user-friendly;
- Make the visitor experience physically and intellectually accessible;
- Provide opportunities for visitors to leave their mark on the Reserve
- Incorporate art in the OWC experience; and
- Present the big picture.

NOAA construction funds were awarded for implementation of the OWC NERR visitor center conceptual plan in FY09. The Reserve issued a request for proposals and begin the design and construction process in 2010. A grand opening is planned for the fall of 2011.

OWC NERR outreach efforts include participation in fairs and conferences, advertisement of programs and volunteer opportunities at local libraries, schools, other government offices, and businesses, support of community based watershed planning and management, news releases, production of a quarterly newsletter that reaches 1,000 residences in the Reserve's watershed, and open houses conducted in partnership with the Friends of OWC.

The reserve will also increase its presence at campus and career fairs, continue participating in the Ohio Department of Natural Resources Real World Learning Curriculum Career features and will seek partnerships with minority serving institutions.

## References

North American Association for Environmental Education, *Environmental Education Materials: Guidelines for Excellence, Guidelines for Learning (Pre K-12) - Executive Summary & Self Assessment Tool, Nonformal Environmental Education Programs: Guidelines for Excellence*, accessed September 26, 2008:

<http://www.naaee.org/programs-and-initiatives/guidelines-for-excellence/>

Ohio Coastal Training Program. (2008). *Training and Technical Assistance to Inform Land Use Planning and Protect Water Quality in Ohio's Lake Erie Watershed: A Front-End Evaluation of Local Official Needs*.

<http://www.dnr.state.oh.us/LinkClick.aspx?fileticket=Awl0HdrSdSg%3d&tabid=15316>

Ohio Coastal Training Program. 2008. *Program Evaluation Summary: Northeast Ohio Stormwater Conference May 21-22, 2008* Prepared for: Tinkers Creek Watershed Partners and Chagrin River Watershed Partners. Available on request from Old Woman Creek National Estuarine Research Reserve, 2514 Cleveland Road East Huron, Ohio.

Ohio Department of Natural Resources Division of Wildlife. 2001. Strategic Plan 2001-2010. [http://www.dnr.state.oh.us/Portals/9/pdf/stratplan01\\_10.pdf](http://www.dnr.state.oh.us/Portals/9/pdf/stratplan01_10.pdf)

The National Geographic Society. 2006. *Ocean Literacy: The Essential Principles and Fundamental Concepts to Lake Erie*

<http://coexploration.org/oceanliteracy/documents/OceanLitChart.pdf>

## Chapter 5. Stewardship Plan

Stewardship of the OWC NERR includes the protection and conservation of the natural resources contained therein. The management of Reserve resources is mandated by state and federal statutory authorities, and implements appropriate public use management policies and watershed technical assistance. Assisting local grassroots organizations outside Reserve boundaries is a critical element to estuarine stewardship since many activities outside the Reserve can have a detrimental impact on the estuary. Such impacts can be mitigated through effective land and water management practices.

The lands and waters that comprise the OWC NERR are equivalent to the state-managed OWC State Nature Preserve (SNP). This area is administered under the authority of the Ohio Revised Code Section 1517. Ohio Nature Preserves are established in “areas that represent characteristic examples of Ohio's natural landscape types and its natural vegetation and geological history” (§1517.02). Nature preserves dedicated under section 1517.05 of the revised code are to be held in trust for the benefit of the people of Ohio for present and future generations. OWC NERR management has the responsibility for land and water conservation within the OWC SNP and to ensure the stewardship of the estuary.

A dictionary definition of stewardship is “the careful and responsible management of something entrusted to one's care.” A previous NERRS Strategic Plan (2005-2010) described stewardship as “the responsible management of coastal resources using the best available information for the purpose of maintaining and restoring healthy, productive and resilient ecosystems.”

To ensure that the Reserve remains a stable environment for the purpose of research and education, the sustainability and natural integrity of the SNP is at the centerpiece of the Reserve's stewardship efforts. However, this is only part of the picture. Stewardship at the Reserve is a broad concept that runs deeper than the management of lands and waters that fall within the Reserve's purview and are identified in this management plan.

The Reserve envisions the OWC estuary as a healthy system whose stewardship sets an example for similar coastal habitats. The Reserve's mission is to influence and encourage the “careful and responsible management” of Great Lakes estuaries. The Reserve can do this by serving as a model of innovative management strategies, practices and outreach to others who manage coastal wetland resources. To accomplish this, the Reserve is working closely with local government agencies to reduce non-point source pollution that can impact the estuary. Finding ways to address Great Lakes coastal resource stewardship is an integral part of many actions of the Reserve, including those of the OWC NERR research and education programs.

## OWC and ecosystem stewardship issues

Although the OWC estuary is one of the best examples of a natural coastal wetland system in the Lake Erie watershed, the estuary and Lake Erie have been impacted by natural and human factors that drive the Reserve's stewardship focus and influence its research and education programs.

Some of these impacts include:

- Stormwater impacts, e.g., sediment and nutrient loading from various land uses

The fine clay soils found on land within the watershed stay suspended in water for long periods. As a result, turbid water conditions in the estuary are common, particularly following storms. Research at OWC NERR has shown positive effects of conservation tillage on sediment loads in the estuary. OWC is located within the central basin of Lake Erie. This portion of Lake Erie is prone to summer anoxic events that can be linked to high phosphorus loads from anthropogenic sources like fertilizer use and wastewater treatment. As a result of increased nutrient loads, harmful algal blooms have also become more frequent in the Lake Erie basin since 1995 (OSGCP, 2004).

- Aquatic and terrestrial invasive species

Throughout the Great Lakes, there is no ecosystem management issue more confounding than invasive species. The ballast water from lake-borne commerce is a prime pathway for the introduction of invasives into the lakes and near shore areas. Over 180 documented aquatic invasive species have entered the Great Lakes with nearly three quarters of that total coming in since the St. Lawrence Seaway opened in 1959. Additional invasions happen on a monthly basis. Many of the species have detrimental impacts on coastal wetland areas like the OWC estuary.

Terrestrial invasive species in the OWC NERR are aided by a large deer population and their browse preferences for native species.

- Loss of wetland and riparian habitat within the Lake Erie watershed
- Ohio ranks second to California in the U.S. in percentage of historical wetland acreage lost. Much of the wetlands in the region were successfully drained and ditched for agricultural use. In the OWC watershed, there remains the potential for restoring some of the wetland function through restoration efforts, particularly along tributary streams.

- Ecosystem impacts of regional climate change

The Intergovernmental Panel on Climate Change warns that regional warming effects have the potential for further reduction of wetlands in the Great Lakes.

There is growing evidence that climate in the Great Lakes have been changing:

- Winters are getting shorter
- Annual average temperatures are growing warmer
- Extreme heat events are occurring more frequently
- Lake ice cover duration is decreasing as air and water temperatures rise
- Heavy precipitation events, both rain and snow, seem more common

Projections include a reduction of lake levels, a primary ecological factor in coastal wetland conditions. This could result in further reductions in wetland area, resulting in poorer water quality in Lake Erie due to the loss of the wetland filters and degraded wildlife habitat. Climate change can accelerate the impact of stormwater, modify conditions to be more hospitable for invasive species, and loss of wetland habitat.

- **Effects of wastewater treatment upstream of the Reserve**

There are no centralized wastewater treatment systems within the OWC watershed. All businesses and households operate with on-site septic systems. Failing systems jeopardize public health and contribute to high nutrient and bacteria loads downstream.

- **Potential for hazardous chemical and other spills**

The transportation network that runs through and adjacent to the Reserve increases the potential for accidental releases into the stream and wetland. Two state highways and a major rail corridor bisect the Reserve; the Ohio turnpike crosses upstream.

- **Watershed development and visitor impacts**

Development of large-scale housing subdivisions have been occurring and additional projects are planned near the Reserve. The influx of new neighbors creates challenges for the Reserve, related to maintaining property boundaries (e.g., trash dumping). Other resource issues are created by the need to allow people access to the estuary and its resources without degrading them. To successfully protect the resources of the Reserve, this “balancing act” must be achieved.

## Stewardship Plan of OWC NERR

This action plan describes stewardship actions and projects to be coordinated by OWC NERR. It encompasses actions that will be taken within the boundary of the Reserve, within its watershed, and regionally. The actions primarily fall into one of four categories: 1) resource protection through the enforcement of laws and statutes, 2) active land management and restoration efforts, 2) regional planning, and 3) land conservation. The Reserve will operate cooperatively with other agencies and organizations in the region to implement the activities outlined in the action plan.



Community volunteer tree planting in the OWC Reserve

<p align="center"><b>VISION: OWC NERR is a regional leader in the stewardship and conservation of a Great Lakes coastal wetland ecosystem</b></p> <p align="center"><b>Mission: Improving the understanding, stewardship, and appreciation of Great Lakes estuaries and coastal wetland ecosystems</b></p>			
GOAL	OBJECTIVES	ACTIONS	PROGRAM AREAS
<b>Improve scientific understanding of the estuary, watershed, and Lake Erie</b>	Reserve ecological conditions are monitored and indicators are developed to serve as a foundation for management-oriented research and for estuarine education	Establish participatory biological surveys in the estuary and watershed	E, R, S
<b>Foster connections to the Old Woman Creek estuary and other coastal ecosystems</b>	Students are attracted to coastal resource management professions	Develop service learning projects and internships for students in wetland management and research	A, E, R, S
<b>Inform decisions of Lake Erie communities and individuals regarding coastal ecosystems</b>	50 citizens adopt or install stewardship practices because of Reserve education programs	Provide homeowner and landowner learning opportunities that demonstrate practices that can benefit the Old Woman Creek ecosystem	A, E, S
		Inform stewardship principles and concepts that are woven into K-12 curriculum	E, S
		Develop on-site stewardship demonstration projects	E, S
	Reserve science and technical expertise is transferred to estuarine stakeholders	Initiate monitoring projects that assess effectiveness of non-point source pollution management practices	E, R, S
		Promote watershed planning and balanced growth in regional communities	E, S
		Provide technical assistance to coastal resource managers	E, R, S

Program Area Key:  
 A - Administration  
 E - Education  
 R - Research  
 S - Stewardship

<b>VISION: OWC NERR is a regional leader in the stewardship and conservation of a Great Lakes coastal wetland ecosystem</b>			
<b>Mission: Improving the understanding and stewardship of Great Lakes estuaries and coastal wetland ecosystems</b>			
GOAL	OBJECTIVES	ACTIONS	PROGRAM AREAS
<b>Enhance the OWC NERR's role as a regional focal point for wetland stewardship science, practice implementation, and education</b>	Reserve ecological conditions are monitored and indicators are developed to serve as a foundation for management-oriented research and estuarine education	Map and track habitat change in the estuary	R, S
		Reduce impacts to state-listed plant species from public use	S
		Reduce deer browse impacts in upland areas	S
	Reserve science and technical expertise is transferred to estuarine stakeholders	Collaborate with local officials to reduce spill impacts to Old Woman Creek, its estuary, and Lake Erie	A, S
	30 acres of the estuary impacted by aquatic invasive species are restored to native aquatic vegetation	Treat invasive species in the estuary	S
		Evaluate invasive species management methods and their impacts on the estuarine ecosystem	R, S
	Sediment and nutrient loading into the estuary is reduced by 25%	Assist in the implementation of the Old Woman Creek watershed clean-up plan	A, E, R, S
	Buffer lands and waters are protected through the Reserve's land conservation strategy	Pursue land conservation opportunities within the OWC NERR area of conservation interest	A, S
		Help foster partnerships to conserve significant natural and cultural features in the OWC NERR stewardship focus area	A, S
	The Reserve's learning environment and the experiences of visitors and users are enhanced	Infuse stewardship messages in public displays and exhibits	A, E, R, S
	Volunteer service on behalf of the Reserve increases	Engage the Reserve advisory council in planning stewardship and restoration actions	A, E, S
		Recruit volunteer assistance for Reserve and watershed stewardship projects	A, E, S

Program Area Key:  
 A - Administration  
 E - Education  
 R - Research  
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## **Resource Protection**

The ODNR – ODW administers the Reserve consistent with the Ohio Revised Code Section 1517. Additional authority to protect Reserve resources exists in state statutes specific to the Division of Wildlife, (ORC 1531, 1533), and the Ohio Administrative Code. These authorities permit the Chief of the Division of Wildlife to make and enforce rules for the protection of lands within the Division's control. In addition to the protective framework for the estuary itself, wildlife species within the Reserve are afforded protection by the Division's statutory authorization. A full listing of Ohio authorities relating to resource protection is included in Appendix L.

The collective statutes curtail or prohibit certain activities within Reserve boundaries. These form the basis for access policies to the OWC NERR, which are outlined in Chapter 7.

## **Law Enforcement**

The ODW is responsible for law enforcement within the boundaries of OWC NERR. The Reserve manager and ODW law enforcement officials (e.g., the Erie County Wildlife Officer) coordinate law enforcement activities. ODNR has more registered law enforcement officers than any other state agency with the exception of the Ohio Highway Patrol, so the Reserve works closely with other ODNR officers including the Divisions of Natural Areas and Preserves and Watercraft.

The Reserve overlays SNP boundaries. All of this area is afforded protection through the Ohio Revised and Administrative Codes pertaining to state nature preserves. Routine inspections are made to identify potential issues with boundary fences and to locate potential encroachments. All boundaries are marked by state nature preserve signs.

The local first responder to a suspected offense within the Reserve would likely be the Erie County Sheriff's Office. In an emergency, the Reserve alarm service promptly notifies the Erie County Sheriff's Office, who have Reserve alarm and front gate codes for accessing the facility. The Center alarm system alerts the Sheriff's Office and the Reserve manager when entry into the facility is attempted outside of normal operating hours.

Reserve staff is alert to educate visitors and dormitory guests about the Reserve and the rules that serve to protect the property. The Ohio Revised Code rules and regulations governing state nature preserves are posted at the trail, within the visitor center, and at the barrier beach access. In most cases, simply informing the offending person about the preserve's protected status is enough to eliminate the unwanted activity. Staff should not intercede to prevent crimes, but should notify Department or local law enforcement personnel. Although not a licensed law enforcement officer, the Reserve manager lives nearby and can assist law enforcement officers.

## OWC NERR Land Management and Restoration

The ODW is responsible for the ecological management of the Reserve. Habitat management and restoration includes fire management, successional mowing, boundary and fencerow maintenance, small-scale site manipulation (e.g., vegetation transects) and the application of selected herbicides and pesticides for the control of invasive species are carried out by OWC NERR and other ODW staff.

Unless managed as a trail, demonstration or management accessway, natural succession will be allowed to continue throughout the Reserve. The demonstration grassland near the visitor center will be mowed and burned as necessary to reduce competition from woody species. Where listed plant species are located, the Reserve will take measures to reduce visitor impacts through access restriction and education.

### Aquatic Invasive Species Control

ODW pursues multiple funding opportunities, such as USFWS Aquatic Invasive Species grants, to reduce the impact of invasive plants on its managed areas. The Reserve manager coordinates large-scale treatments within the Reserve with Division of Wildlife district personnel.

The Lake Erie ecosystem is highly dynamic. Change can be rapid depending on a variety of conditions. The Great Lakes returned to average water levels after a peak water level period ended in 1999. Since then, annual and seasonal water levels in the lake have closely approximated their long-term average based on historical data. This created ideal growing conditions for aquatic plant species. When the water levels dropped in the late 1990s, mudflat areas were quickly colonized by *Phragmites australis*, the common reed, which is a highly aggressive invasive species in the Great Lakes.

Common reeds rapidly expanded from the mouth of the estuary and had inundated over 30 acres of the estuary, greatly reducing plant diversity in the affected areas. The ODW began an aerial spray treatment of the estuary around Star Island in the summer of 2005. An additional treatment took place in 2006. Other restoration monitoring programs are planned to evaluate effects on wildlife species that depend on wetland vegetation as habitat.

In addition to the Common reed, the Reserve will prioritize the treatment of aquatic areas impacted by invasives, such as purple loosestrife (*Lythrum salicaria*) and reed canary grass (*Phalaris arundinacea*). One such area, the southern boundary of the Reserve at Darrow Road will be restored to native species through the control of reed canary grass. A project description for the Darrow Road restoration is included in Appendix M.

Upland areas are also impacted by invasive species. Garlic mustard (*Alliaria petiolata*), honeysuckle species, autumn olive (*Elaeagnus umbellata*), multiflora rose (*Rosa multiflora*), Japanese barberry (*Berberis thunbergii*), and privet (*Ligustrum* sp.) in upland areas will also be controlled, as resources permit.

## Deer Management

In 2000, the Reserve conducted an aerial infrared survey of deer populations on a typical winter night. Deer herd within the Reserve during that survey were well above typical levels for a habitat of its size. The Reserve has several crop fields in the vicinity. Deer seem to browse in these areas until the crops are harvested, and then migrate into the protected refuge of the Reserve for the winter.

In order to reduce the impacts of the abundant population (e.g., browse and crop damage, deer-vehicle accidents), the articles of dedication that establish the OWC state nature preserve were amended and hunting was authorized in 1998. The Reserve will begin an evaluation of browse damage reduction within this plan's duration, focusing on native plant species such as Large-flowered trillium (*Trillium grandiflorum*). Other regional studies show that deer browse has a correlation with stem heights in plant species like trillium, which are one of the more popular spring wildflower species in upland areas. A 2008 winter survey of deer populations in the Reserve showed a positive reduction in total deer. Deer management is approaching a "maintenance" mode wherein controlled hunts can be a management tool to maintain healthy populations.

## Reserve Management Zones

Figure 9 shows the locations of management zones within the Reserve. These distinctive habitat areas may face different issues and will be managed according to the following principles:

### Zone A. Barrier beach habitat

- The sand bar will be allowed to open and close due to natural conditions
- Boundary signs will be maintained to the west and east at Oberlin Beach to reduce the potential for Reserve visitor trespass onto private property
- Beach listed species like purple sand grass will be protected by fencing
- Aggressive plant species like autumn olive and soapwort (*Saponaria officinalis*) will be controlled as resources permit
- Swale running through marsh and across barrier beach will be periodically cleared of debris

### Zone B. Estuary

- To maintain ecological health of freshwater estuarine wetland, some active management is necessary
- Common reed) and reed canary grass will be controlled as resources permit
- The establishment of other aggressive wetland plant species like purple loosestrife and flowering rush (*Butomus umbellatus*) will be controlled
- Control of aquatic invasive plants will be coordinated with research partners to maximize restoration science potential

Figure 9. OWC NERR management zones



Zone C. Eastern upland mid-succession habitat in proximity of DeWine Center

- Succession is allowed to continue
- Trails will be maintained as needed
- Upland aggressive plant species, e.g., garlic mustard, honeysuckle sp., privet sp. will be treated as resources allow

Zone D. Eastern upland succession habitat

- Management lanes will be maintained as needed
- Narrow safety zone will be cut to protect Huron Green subdivision homes during controlled deer hunts
- Fence lines will be kept clear

Zone E. Eastern upland mixed hardwood forest

- Succession to climax mixed hardwood forest is allowed to continue
- Additional management lane along eastern boundary may be cut to allow equipment access
- Warm season grass prairie area near railroad track to be burned as resources allow

Zone F. Warm season grass prairie near DeWine Center

- Area to be mowed annually and burned as needed to reduce woody plant competition with warm season grasses

Zone G. Darrow road floodplain

- Site to be restored through the removal of reed canary grass and the planting of water-tolerant tree species (restoration plan in Appendix M).

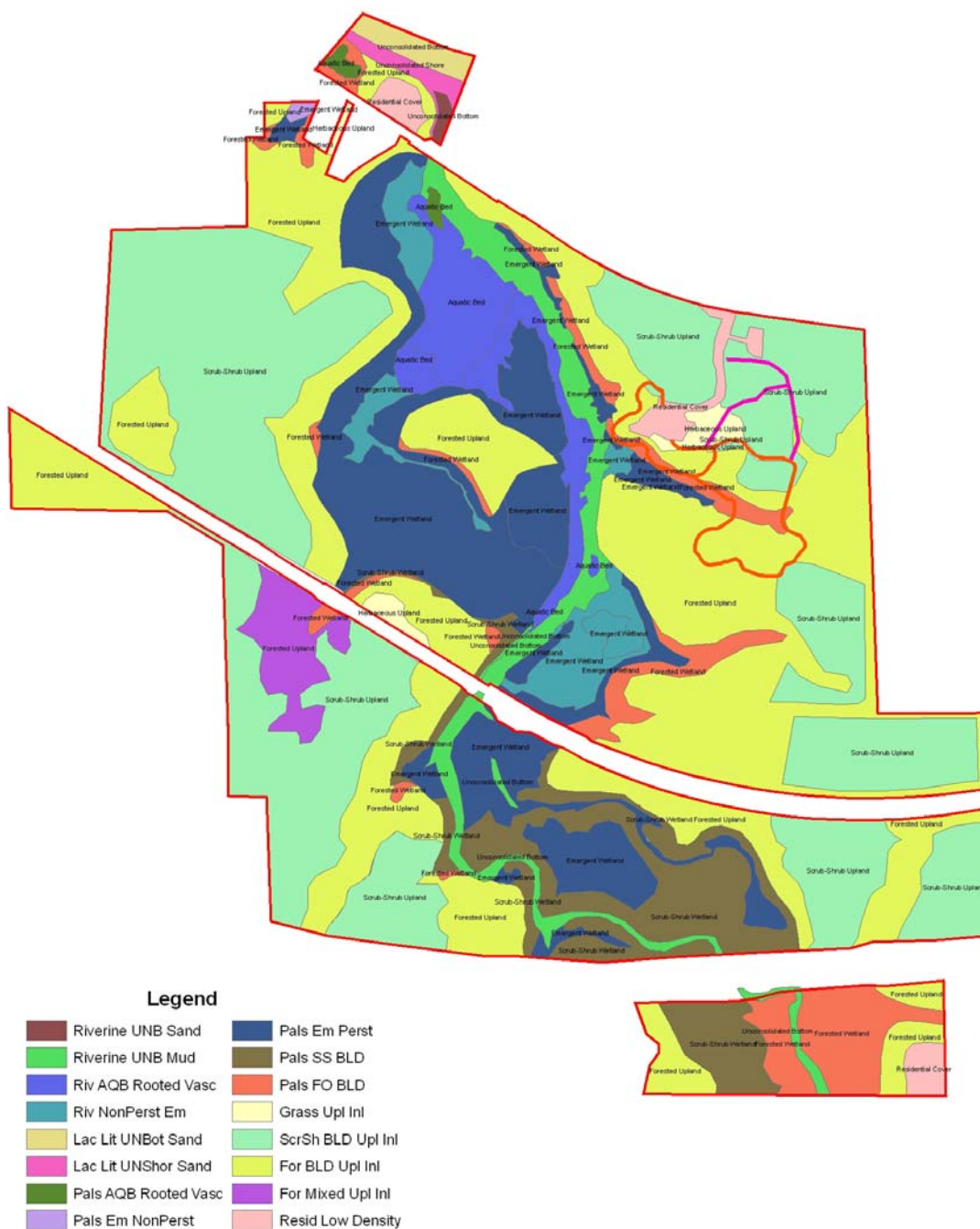
## **Geographic Information Systems**

Reserve spatial data is becoming increasingly important to the effective stewardship of Reserve resources. Data is also available for Reserve research and outreach. All data products originating from the Reserve will comply with federal data reporting standards as established by the Federal Geographic Data Committee. All GIS products are available to NOAA, ODW, and research/stewardship partners as needed. The Reserve will focus on assisting local watershed management through the use of its GIS database and through additional spatial analysis. GIS datasets from the Reserve have been used for watershed planning, tracking habitat change, illustrating journal articles, defining survey extent for training needs assessments and basic map-making from base layers.

## **Habitats of the OWC NERR**

The habitats of the Reserve have been classified using a NERR system scheme (Figure 10), based on a Cowardian classification system (Appendix S). The climax landscape in the uplands is a mixed-hardwood forest. Estuarine habitats shift periodically based on stream hydrology including Lake Erie water level influence.

Figure 10. OWC NERR habitat classification



## **Stewardship outside the Reserve Boundaries**

To develop a realistic sustainable strategy for Reserve stewardship-actions, outreach and scientific discovery must take place upstream of the estuary. Therefore, it is critical that the Reserve look beyond its boundaries and involve watershed residents and their actions in its overall stewardship strategy.

### **OWC NERR role in watershed management**

In August 2005, the U.S. EPA approved an Ohio EPA Total Maximum Daily Load (TMDL) report for the OWC watershed. A TMDL is a written, quantitative assessment of water quality problems in a stream and its contributing sources of pollution. It specifies the amount a pollutant must be reduced to meet water quality and designated use standards, allocates pollutant load reductions, and provides the basis for taking actions needed to restore the stream. The report findings relied partially on research conducted at the OWC NERR relating to sediment loading. The report found the primary causes of impairment in the OWC and neighboring Chappel Creek watersheds to be nutrient/organic enrichment, siltation, and habitat alteration. Of the three impairment causes (siltation, nutrient enrichment and habitat alteration), siltation is the most important factor in the OWC watershed and can be traced back to sources such as agricultural tillage practices and in-channel erosion during peak flows.

In the spring of 2006, the Ohio CTP facilitated several meetings between local agencies such as the Erie Soil and Water Conservation District (Erie SWCD), the Friends of OWC, Friends of Pipe Creek Watershed, and Reserve staff. From these meetings, a partnership developed that lead to the submission of a grant request to establish a watershed coordinator position at the Erie SWCD. The grant was approved in the summer of 2006, and the Erie SWCD has hired a watershed coordinator to lead a locally driven effort to create a watershed “clean-up” plan for OWC and implement a sustainable watershed management effort in the OWC and Pipe Creek watersheds. The Reserve supports the local effort in the watershed and plans to assist the partnership through its outreach efforts and by providing data. The Reserve will also attempt to evaluate management practices undertaken to reduce sediment and nutrient loads into the stream and estuary that emerge from the planning process.

In 2009, the Ohio EPA and ODNR approved the watershed clean up plan for OWC. The plan used Reserve research and monitoring data extensively as the science that guided protection and restoration actions. In 2010, the ODW established an MOU (Appendix W) with the ESWCD describing the administrative roles each would play in a sustainable regional watershed program, including streams like OWC. The MOU creates a sustained watershed coordinator position to begin implementing projects associated with the OWC cleanup plan and to start building capacity for planning in other regional watersheds.

Community involvement in the watershed program includes a volunteer monitoring program in OWC and other area streams. This program trains volunteers to investigate the water quality of three local streams: OWC, Pipe Creek, and Sawmill



Creek. A total of 18 sites are monitored once a month from April to November. Chemical monitoring performed on-site by the volunteers include pH, temperature, turbidity, and dissolved oxygen. Grab samples collected by the volunteers are taken back to two partnering laboratories (OWC NERR and Sandusky Wastewater Treatment Plant) for completion of water chemistry: ammonia, nitrate, soluble reactive phosphorous, turbidity, and conductivity. Macroinvertebrate monitoring of selected sites in OWC and Pipe Creek began in spring of 2010. Currently a total of 6 sites are sampled using kick seine methods at riffle sites. Macroinvertebrates collected are identified by order and taxa group to develop a cumulative index value for the stream quality assessment.

### **Emergency Spill Response**

The Reserve is transected by two east-west highways and one of the more highly used rail systems in the U.S. In addition, the Ohio Turnpike crosses the creek near the village of Berlin Heights. Because of these areas of intensive use, the Reserve is susceptible to spills that occur following accidents or derailments. The Reserve completed a spill response plan in 1991 and acquired spill response gear such as soft boom.

In 2005, Reserve staff initiated meetings with local emergency response officials, who agreed to review the spill response plan. The review showed that some of the response process steps are outdated and should be revised. In addition, the officials recommended that the Reserve take steps to identify locations within the watershed where emergency response gear can be sited for rapid deployment.

## Land Conservation Plan for OWC NERR

Population in the vicinity of the OWC NERR experienced a sustained increase from the 1940s until the 1970s. Population growth in the area then underwent a modest decline until a slight upturn in the early 1990s. It was anticipated that the completion of State Route 2 (1989), which bisects the southern portion of the Reserve, would produce an increase in development in the area. Holly (1986) performed a demographic analysis of the region and forecast steady increases in population in the townships and cities contiguous to as well as near the Reserve, partly attributable to the new highway's impact.

Figure 11 shows land cover within the OWC watershed in 2003. While rapid population growth has not occurred as predicted, driving forces would seem to indicate that the area is still likely to undergo change. Population expansion forecasted will likely still occur, just at a slower rate than anticipated.

- The OWC area lies within the “commuting shed” of Cleveland, that is, the area within which highway connections make commuting to work practical. Workers commuting to the Toledo metropolitan area must travel just a few minutes further.
- Numerous studies (e.g., National Park Service, 1995) have revealed increases in property values in instances where the property is located near or adjacent to open spaces like the OWC NERR.
- The local school district in the watershed, Berlin-Milan Local Schools, has an excellent reputation for student achievement.
- Over 65% of the watershed was in agricultural use during 2003.

## Land Cover for Old Woman Creek Watershed in 2003

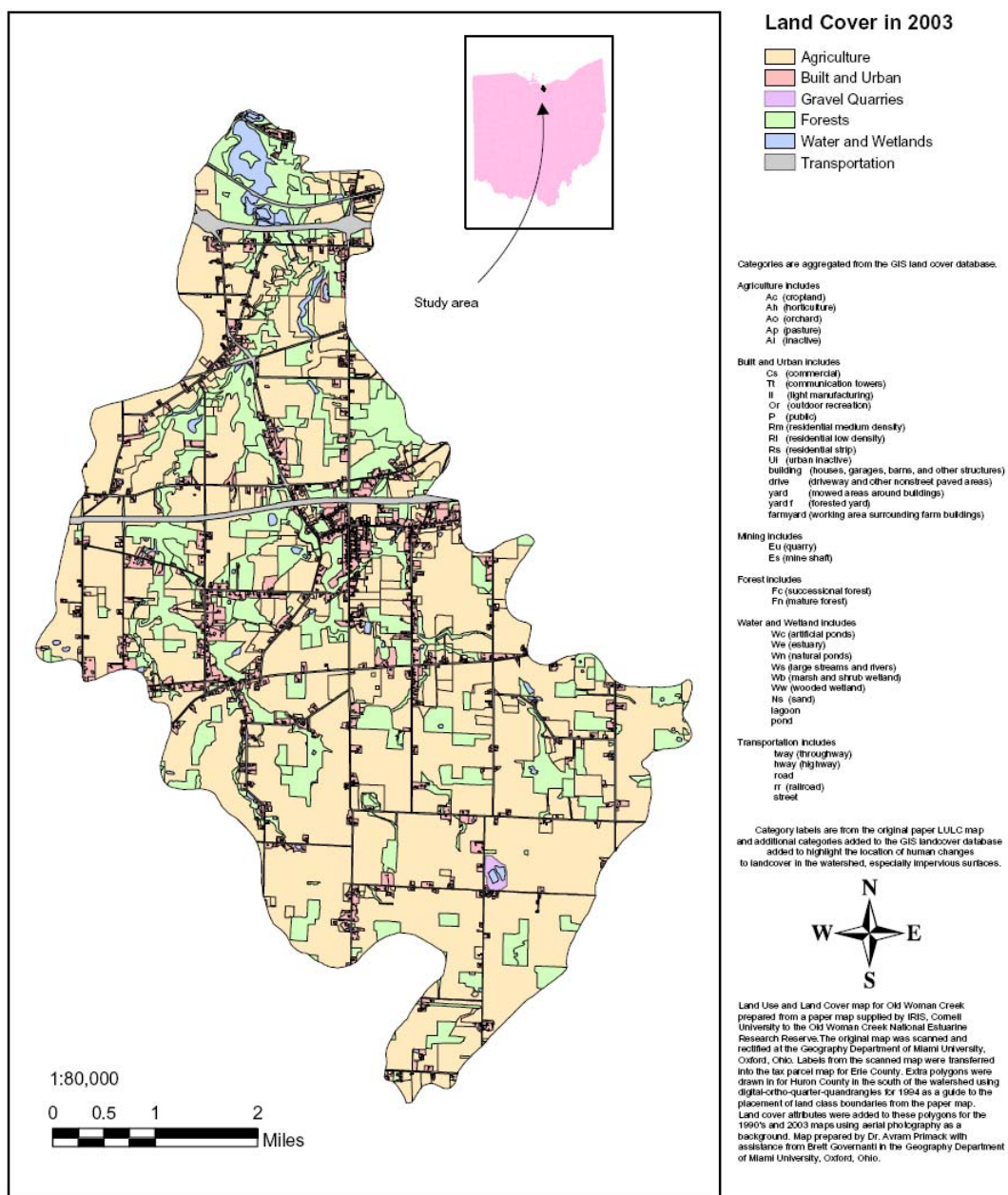


Figure 11. Land cover in the OWC watershed in 2003.

Although the watershed remains mostly agricultural, the significance of this last point requires some elaboration. As is the case in many rural communities, recent offspring of farm families in the area may not be as inclined to pursue their living in agriculture, which may make farmland in the watershed increasingly available for residential development. Very few of the agricultural operations are full time. Most farms are managed as a second income. These factors taken together make the vicinity of the OWC Reserve a highly regarded place for potential residents seeking a more “rural” lifestyle.

Arterial streets within the watershed (Route 61, Berlin Road) have water lines, which is an improvement over the slower yielding wells dug in other sections of the basin. Spurred by efforts to provide county or rural provider water service throughout the basin, new housing will have the potential to result in more water quality impairments and habitat loss. Effects may include:

- Siltation and sediment-laden runoff during house and road construction;
- Faster precipitation runoff rate from impervious areas which in turn increases siltation and stream bank erosion due to the increased velocity;
- Increased number of failing septic systems by virtue of increased housing units.

In the OWC watershed, there is no centralized sewer service. Area zoning requires a 1.5-acre minimum lot size. The provision of county water will bring about additional residential development and home sewage treatment systems. Home septic systems, if not properly maintained, may be expected to fail and add bacteria and nutrients to OWC and its tributaries.

This development pattern is already underway along some of the aerial roads in the area such as Route 61, Mason Road, and Berlin Road.

The 2000-2005 OWC NERR Management Plan identified parcels that should be considered for fee simple, conservation easement or bargain sale in the event landowners would be willing to sell. In 2004, the OWC NERR acquired by fee simple 2.2 acres adjacent to the Reserve boundary and received the benefit of a 0.55 acre donated conservation easement in an adjacent housing development.

### **OWC Watershed Resources**

OWC flows 15 miles through portions of Huron and Erie counties before draining into Lake Erie 3 miles east of the city of Huron, Ohio (See watershed map-Figure 12). Slopes are steep near the southern headwaters in the glacial till plain. This till plain lies southeast of an ancient beach ridge and is a more rolling topography than the plains nearer to Lake Erie. The till plain is the area where the last glacier (approximately 14,000 YBP) ice edge advanced and retreated rapidly without halting (Herdendorf et al, 2004). As a result, the till plain is an expanse of deposited ground moraine that extends beyond the limits of the watershed in southern Huron County.

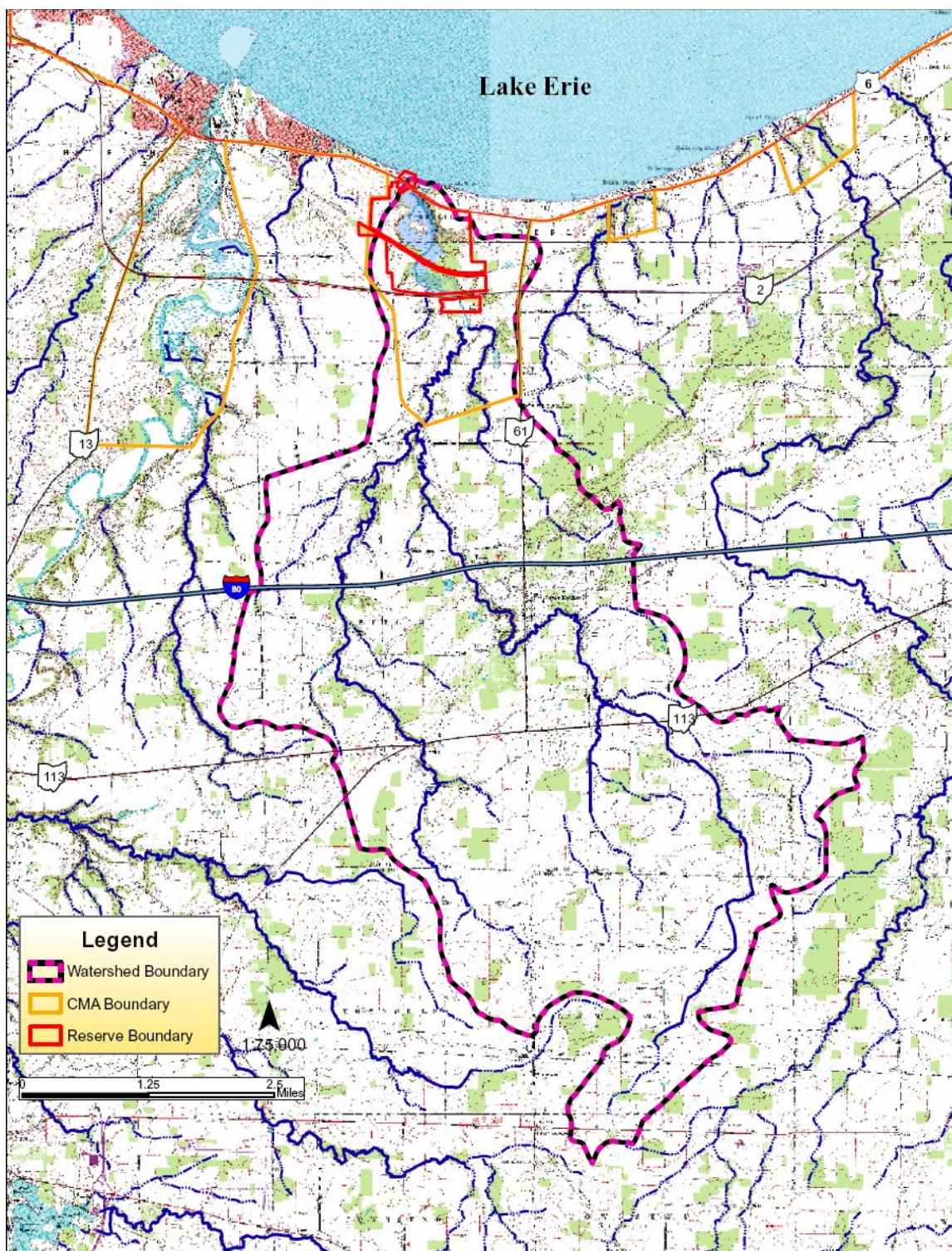
After the creek passes through the village of Berlin Heights and flows over the Berea glacial escarpment, the stream slows and meanders through crop fields in Lake plain topography. In the vicinity of the intersection of Berlin and Barrows Road, the creek passes through its most lakeward riffle and pool area. This area is the most upstream point that has been recorded as being under Lake Erie influence, making it a strategic point for conservation planning. A tributary stream flows out of the Edison Woods Preserve, an Erie County Metro Park. Edison Woods is one of the largest protected natural areas along the Lake Erie coast.

About a mile before entering Lake Erie, the channel of OWC becomes submerged and the slow moving estuarine portion of the creek flows northward to the lake at the mouth of the Creek.

Over 67% of the land within the 27 square mile (69 km<sup>2</sup>) OWC watershed is used for agriculture. The close proximity to Lake Erie moderates the area's climate and extends the growing season, so row crops (e.g., corn, soybeans) and fruit orchards have been a long time fixture of the watershed. Many of watershed's early businesses, such as cider mills and basket factories, were established in support of the fruit industry.

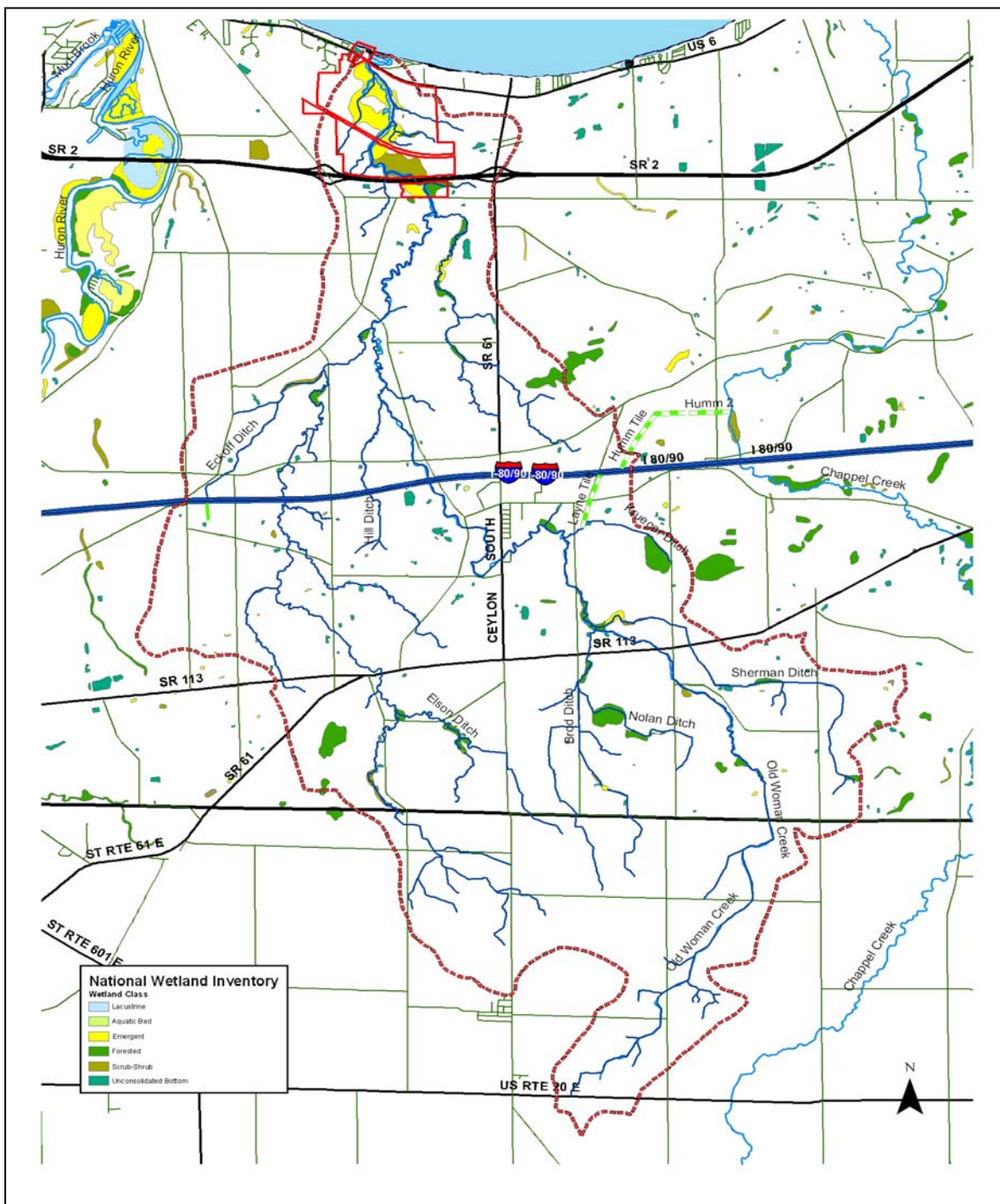
Results of research conducted by Matisoff & Evans, 2002 and by Evans & Seamon, 1997 shows that conservation tillage or other erosion control best management practice would greatly reduce sediment inputs into the OWC tributaries and estuary. Sediment has been shown to travel from the headwater tributaries of OWC to Lake Erie, often within the same storm event.

Wetlands within the watershed are primarily classified by the National Wetland Inventory (NWI) as within the "woods with hydric soils" type (Figure 13). Many areas now in agricultural use in the watershed are drained by tile fields. Wetland restoration could take place in many of these areas by restoring the natural hydrologic regime. The Reserve hopes to identify a research partner to perform a peak hydrograph analysis of the watershed, showing the prime restoration areas based on floodplain storage and wetland restoration potential.



**Figure 12. OWC watershed**

Figure 13. NWI wetlands, OWC watershed



An impressive natural feature left by glaciations is the ravine of OWC at Berlin Heights, which is the maximum relief area in the watershed (Herdendorf et al, 2004). From the floor of the creek to the top of the gorge, the vertical heights of the embankments reach a maximum of 27m and the width ranges from 100m to nearly 200m. The ravine begins at the foot of the Berea Escarpment, near the place where the Ohio Turnpike crosses the eastern branch of OWC and extends south to Ohio Route 61 through Berlin Heights. Another glacial remnant gorge area is in the vicinity of Berlinville, near Route 113.

The most visible endangered wildlife species in the OWC watershed is the American Bald Eagle (*Haliaeetus leucocephalus*), which has made a remarkable recovery in Ohio's Lake Erie coastal region and many of the state's inland riverine systems and reservoirs. In 1979, Ohio Bald Eagle populations had fallen to four nesting pairs. Erie County, in which the Reserve is located, had 11 viable nests in 2005 and Ohio has passed the milestone of over 100 nests around the state. Bald Eagles first nested within the Reserve in 1995. Since then, three different nest sites have been used by nesting pairs to fledge 15 eaglets. The Indiana Bat (*Myotis sodalis*) and the Eastern Massasauga Rattlesnake (*Nerodia erythrogaster neglecta*) also have historic ranges that include Erie County. Additionally, there are two threatened species of fish and two mollusks. State species of concern include the Eastern fox snake (*Elaphe gloydi*) and prothonotary warbler (*Protonotaria citrea*). Totals of listed wildlife and plant species surveyed within the Reserve, watershed, and near shore Lake Erie are included in Table 2 and 3 on the following page.

Two archaeological sites (Jenkins and Anderson) overlook the OWC estuary and data were recovered from the sites in 1976-77 as part of a highway mitigation project prior to construction of Ohio Route 2. These sites document occupation by Paleo-Indian, Archaic, and Woodland peoples (e.g., see Seeman and Bush, 1979; Shane 1981, 1992). Within the Jenkins site, which is situated on a promontory forming the eastern bluff of the OWC valley, surface surveys indicated that the vast majority of the Jenkins site lies within the Reserve north of Route 2. Within the Anderson site, excavations revealed that most of the cultural materials were in the upper 60 cm of sand deposits. The occupational history of the site starts in the Paleo-Indian period (10,500 – 9,000 YBP).



**Table 2. Listed Animal Species, OWC Reserve, Watershed, Nearshore Lake Erie**

	<b>Endangered</b>	<b>Threatened</b>	<b>Ohio Species of Concern</b>
Mammals	0	0	1
Birds	13	7	5
Reptiles	1	1	2
Amphibians	0	0	1
Fish	0	2	4
Mollusks	0	2	3

Source: Herdendorf et al, 2004

Several listed plant species have been identified within the Reserve and watershed.

**Table 3. Ohio Listed Plant Species in OWC Reserve and Watershed**

<b>Scientific name</b>	<b>Common name</b>	<b>State Status</b>
<i>Acorus americanus</i>	American Sweet-flag	Threatened
<i>Apocynum sibiricum</i>	Clasping-leaved Dogbane	Threatened
<i>Artemisia campestris</i>	Beach Wormwood	Endangered
<i>Cakile edentula</i>	Inland Sea Rocket	Potentially Threatened
<i>Carex appalachica</i>	Appalachian Sedge	Threatened
<i>Carex aquatilis</i>	Leafy Tussock Sedge	Potentially Threatened
<i>Carex bebbii</i>	Bebb's Sedge	Potentially Threatened
<i>Carex bicknellii</i>	Bicknell's Sedge	Threatened
<i>Carex lasiocarpa</i>	Slender Sedge	Potentially Threatened
<i>Carex retroflexa</i>	Reflexed Sedge	Potentially Threatened
<i>Cyperus schweinitzii</i>	Schweinitz' Umbrella-sedge	Threatened
<i>Euphorbia polygonifolia</i>	Seaside Spurge	Potentially Threatened
<i>Gymnocarpium dryopteris</i>	Common Oak Fern	Threatened
<i>Helianthemum bicknellii</i>	Plains Frostweed	Threatened
<i>Ranunculus fascicularis</i>	Early Buttercup	Potentially Threatened
<i>Sisyrinchium mucronatum</i>	Narrow-leaved Blue-eyed-grass	Endangered
<i>Spiranthes magnicamporum</i>	Great Plains Ladies'-tresses	Potentially Threatened
<i>Triplasis purpurea</i>	Purple Sand Grass	Potentially Threatened

Source: Ohio Natural Heritage Database

## **Area of Conservation Interest**

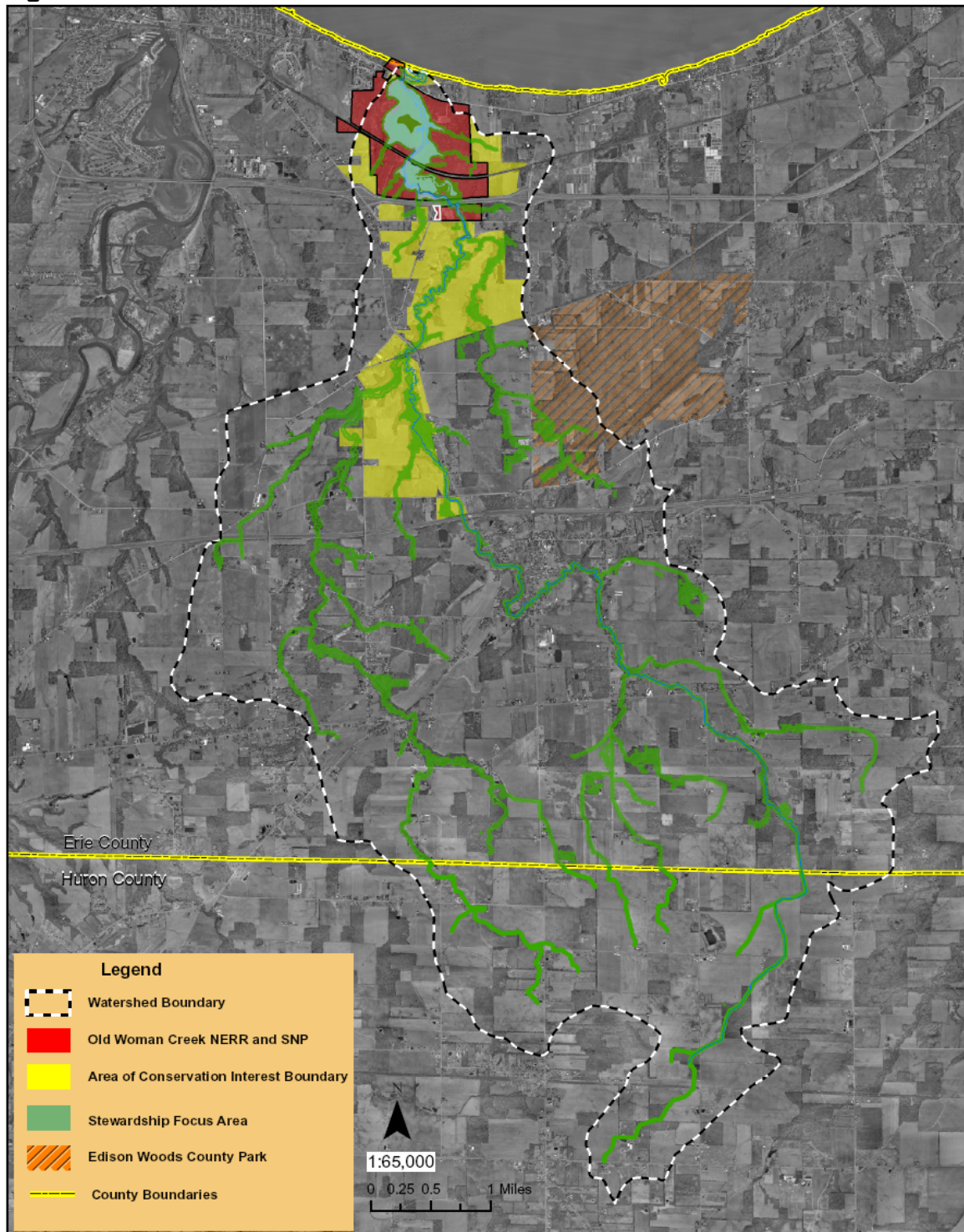
The Area of Conservation Interest and Stewardship Focus Corridor rely on the use and analysis of geographic information system (GIS) data. A spatial model of the watershed has been developed that identifies these areas, and property within the areas, and categorizes them based on the existence of any of the following factors:

- location within the OWC watershed;
- direct hydrologic connection to the OWC estuary;
- lands containing a 100-foot buffer area around any tributary stream section;
- proximity to within 200 feet of a wetland identified as part of the Ohio Wetland Inventory.

The OWC NERR Area of Conservation Interest includes all stream sections that have been shown to be under Lake Erie influence during high water level periods and through periodic seiche activity. These land and water areas of the Area of Conservation Interest contain or abut stream sections and wetlands south of the Reserve that have the most direct impact on Reserve resources and water quality. Conservation of these lands by some form of acquisition would maintain the ecological integrity of the downstream OWC estuary.

Lands acquired in fee simple within the Area of Conservation Interest or under a memorandum of understanding (MOU) will be managed by the Ohio Division of Wildlife/OWC NERR, consistent with the Division's authority to own and manage land (ORC 1531.06). This authority includes the ability to establish rules regarding the governance of lands within the Division's control. The Area of Conservation Interest includes over 1,200 acres of land and water area. Figure 14 on the following page shows the land conservation classes of the OWC NERR.

Figure 14. OWC NERR land conservation classification



### **Cost analysis**

Figure 15 marks the location of two tiers of the OWC Area of Conservation Interest. Many parcels within Tier 1 of the Area of Conservation Interest contain large lot rural home sites with agricultural fields. Using GIS and county auditor records, the Reserve matched market land value to parcel boundaries. The Reserve cost analysis does not include homes, barns, etc., and bases an average cost per acre only on appraised land value without structures.

NERR regulations in section 921.13 mandate that Reserve acquisition plans include the following elements:

- A list of specific parcels prioritized for acquisition;
- An estimate of the fair market value for these parcels;
- An estimate of the time required to achieve adequate state control; and
- A ranked list of priorities.

OWC NERR uses this method in an aggregated fashion to analyze the Area of Conservation Interest. The point at which two tributaries combine to form the main stem of OWC occurs near a railroad bridge on Berlin Road. This is also where the first upstream riffle occurs. From that point to Lake Erie constitutes the estuarine portion of OWC. All of the Tier 1 stream sections are the highest priority for OWC NERR conservation given their potential for protecting the estuarine area. Table 4 (Tier 1) and Table 5 (Tier 2) shows the total lands in acreage and the average value per acre of lands within the Area of Conservation Interest.

Figure 15. Buffer Tiers, Area of Conservation Interest

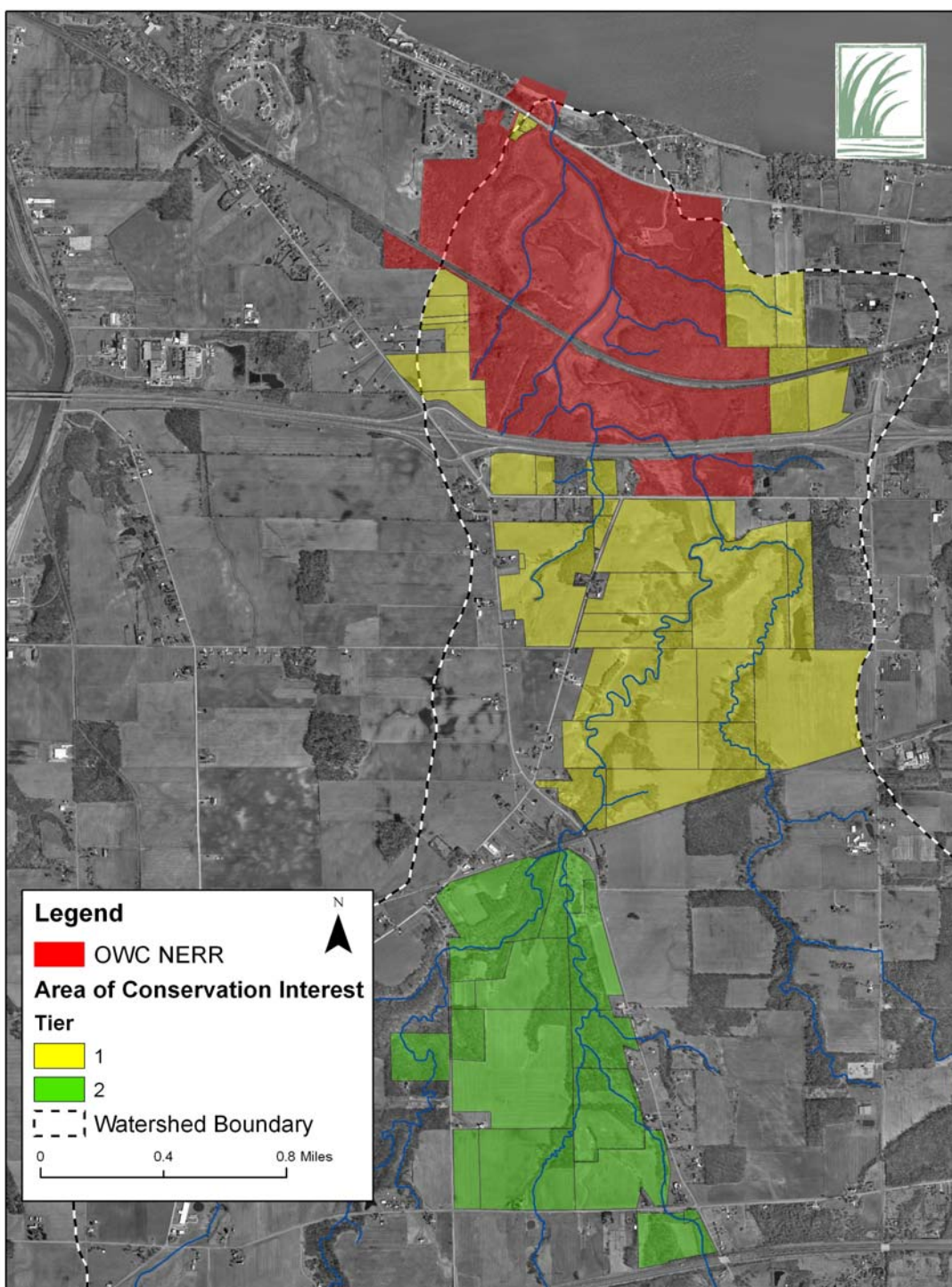


Table 4. **Area of Conservation Interest, Tier 1**

<b>Total acres</b>	<b>Habitat values present</b>	<b>Average cost per acre</b>	<b>Minimum effective level of acquisition</b>
852.5	<ul style="list-style-type: none"> <li>▪ Natural and created wetlands</li> <li>▪ Riparian</li> <li>▪ Mixed hardwood forest</li> <li>▪ Upland lake plain in agricultural production</li> </ul>	\$3,087	Conservation easement

Figure 15 shows lands that falls in the Area of Conservation Interest Tier 2. This section includes riparian parcels from the first upstream riffle up to the Village of Berlin Heights.

Table 5. **Area of Conservation Interest, Tier 2**

<b>Total acres</b>	<b>Habitat values present</b>	<b>Average cost per acre</b>	<b>Minimum effective level of acquisition</b>
757.9	<ul style="list-style-type: none"> <li>▪ Natural and created wetlands, e.g., floodplains</li> <li>▪ Riparian</li> <li>▪ Mixed hardwood forest</li> <li>▪ Upland lake plain with rural development and agricultural fields</li> </ul>	\$2,833	Conservation easement

Typical conservation easements in Northern Ohio are negotiated at approximately 50% of the assessed value of the land per acre.

## **Stewardship Focus Corridor**

Beyond the Area of Conservation Interest is a Stewardship Focus Corridor (SFC). The SFC has been identified where conservation can have a demonstrable downstream water quality benefit. The focus of the SFC is on all stream tributaries in the watershed and wetlands near riparian areas, regardless of their size or type. Acquisition and direct management of parcels adjacent to this Stewardship Focus Corridor is not the highest priority, but the Reserve would consider acquisition within the SFC if willing sellers appear, depending on funding availability, the land's ecological significance, management requirements, and education/access potential.

## **Land Use and Regulation**

The majority of the parcels identified in the Area of Conservation Interest and Stewardship Focus Corridor are within Berlin Township. With the exception of several light industrial and commercial parcels and the incorporated Village of Berlin Heights, lands are zoned for Agricultural/Residential uses. Within this Township classification, minimum lot size is 1.5 acres in order to accommodate on-site septic systems, and a minimum road frontage of at least 200 feet is required. Floodplains within the Township are protected by a Floodplain, Floodway, and Wetland Overlay District, which specifies some restrictions on use of land within these designated areas.

There are approximately 1,000 residences in the OWC watershed, and all are on septic systems. Many of these existing home sites or farm headquarters do not meet the minimum lot sizes of the Township's zoning.

## **Acquisition Methods**

OWC NERR would choose the appropriate method of conservation from a range of options, such as fee-simple, conservation easement, bargain sales, and memoranda of understanding. The ultimate method would depend on several factors:

- ecological value, including the presence of listed species
- potential for research, educational, and public access
- assessed cost
- location
- resource commitments necessary to manage the property

In most cases within the Area of Conservation Interest, less-than-fee simple methods such as conservation easements could be used to protect the estuary.

Easement agreements can allow Reserve use of the area for long-term research and monitoring. To facilitate adequate resource conservation and a stable platform for future research and education, the Reserve will work with easement grantors to develop management plans for conserved areas.

Regional land trusts have the capability to do pre-acquisitions on behalf of the NERR. In an instance such as this, the Reserve would work closely to develop a cooperative agreement with the land trust to achieve compatible conservation goals and to articulate management responsibilities.

In situations where acquisition is not an option, the Ohio Division of Wildlife has an active private lands management section that seeks to assist landowners in understanding the range of conservation options and incentives available. These agriculture and wetland assistance programs yield measurable habitat and water quality improvements. The Reserve will seek to collaborate with the private lands program as warranted in both the Area of Conservation Interest and the Stewardship Focus Corridor.

### **Funding Sources**

The Reserve is fortunate to have several potential funding sources for conservation when a willing seller is identified. The Division of Wildlife has several funding sources for wetland conservation. The OWC NERR program fund, which is administered by the Columbus (OH) Foundation, has land conservation as a priority.

The primary NOAA-administered land conservation funding source is the Coastal and Estuarine Land Conservation Program (CELCP). A 2009 congressional action acknowledges conservation benefiting the NERRS system as a national priority. A percentage (currently 15%) of the congressional appropriation to the program is to be set aside for land acquisitions benefiting the NERRS. ERD collaborated to define the targeted watershed areas that would meet the criteria of beneficial acquisitions on behalf of the NERR. The OWC NERR targeted watershed corresponds to the watershed boundary as depicted in Figure 12. This means the full extent of the Area of Conservation Interest and Stewardship Focus corridor are within the targeted area for CELCP consideration. The Reserve will work closely with the Ohio Coastal Management Program to pursue conservation opportunities using the CELCP funding for the appropriate projects.



## References

Evans, J.E. and D.E. Seamon. 1997. A GIS model to calculate sediment yields from a small rural watershed, Old Woman Creek, Erie and Huron counties, Ohio. *Ohio J. Sci.* 97(3):44-52.

Herdendorf, C.E., D.M. Klarer, and R.C. Herdendorf. 2004. *The Ecology of Old Woman Creek, Ohio: An Estuarine and Watershed Profile*. Ohio Department of Natural Resources, Division of Natural Areas and Preserves, Columbus, Ohio. 448 pp.

Holly, B.P. 1986. *Demographic, Land Use, and Environmental Forecasts for the Old Woman Creek National Estuarine Sanctuary, 1985-2005*. Final research report submitted to Sanctuary Programs Div.-NOAA/NOS and Ohio Dept. Natural Resources, Div. Natural Areas and Preserves, Columbus, OH. 79 pp.

Matisoff, G., E.C. Bonniwell, and P.J. Whiting. 2002a. Soil erosion and sediment sources in an Ohio watershed using beryllium-7, cesium-137, and lead-210. *J. Environmental Quality* 31(1):54-61.

Matisoff, G., E.C. Bonniwell, and P.J. Whiting. 2002b. Radionuclide as indicators of sediment transport in agricultural watersheds that drain to Lake Erie. *J. Environmental Quality* 31(1):62-72.

National Park Service, Rivers, Trails and Conservation Assistance Program, "Economic Impacts of Protecting Rivers, Trails, and Greenway Corridors," 4<sup>th</sup> ed. (Washington, DC: National Park Service, 1995)

Ohio Sea Grant College Program. 2005. 2005-2010 Strategic Plan. Publication OHSU-TB-045. The Ohio State University, Columbus, Ohio. 36 pp.

## Chapter 6. Administration of the OWC NERR

The Estuarine Reserves Division of the Office of Ocean and Coastal Resource Management (OCRM) administers the reserve system. The Division establishes standards for designating and operating reserves, provides support for reserve operations and system-wide programming, undertakes projects that benefit the reserve system, and integrates information from individual reserves to support decision-making at the national level. As required by Federal regulation, 15 C.F.R. Part 921.40, OCRM periodically evaluates reserves for compliance with Federal requirements and with the individual reserve's Federally-approved management plan.

Administration of the Reserve program depends upon several components that are described in this plan section. The partner agencies, ODW and ERD, provide the administrative support and direction for Reserve activities. Reserve staff fosters institutional partnerships that facilitate achievement of Reserve goals. These partnerships include other NOAA-affiliated programs within Ohio, government agencies like the local soil and water conservation district, and community support through the Reserve's advisory council, through Friends of OWC and through program volunteers. An outline of the Reserve's actions related to maintaining a robust volunteer program are included within this section, as are anticipated facility needs and planned construction within the time frame of this management plan.

### State Partner: Ohio Division of Wildlife

In 2004, the cooperating state agency for the Reserve transferred from the ODNR-Division of Natural Areas and Preserves (DNAP) to the ODW. ODNR developed a memorandum of understanding between Division of Wildlife and DNAP that designed the process for the transfer of the program (Appendix N). The change in administration includes responsibility for the management of the OWC state nature preserve. The internal transfer of the preserve is noted in Appendix O.

The Reserve falls within the ODW Wildlife Management and Research section and is one of four wildlife research stations (WRS) administered by the section. Staff members assigned to the Reserve are classified, temporary, or contractual employees of the ODW. The ODW Wildlife Management Executive Administrator provides guidance to the Reserve Manager and promotes integration of the Reserve with WRS and collaboration with other ODW programs. The ODW manages several wildlife and fisheries research facilities throughout Ohio, which conduct management-oriented research to improve ODW management of Ohio's fish and wildlife resources.

As an agency of over 400 employees and a variety of field operations, the ODW has a decentralized business structure to the maximum degree practical. The Reserve manager has on-site responsibility for ensuring compliance with state purchasing rules, making preliminary purchasing approvals, contract development, grant tracking and reporting, budget development, payroll, and inventory control. Various personnel within the ODW central business office assist with securing

purchasing and contract approvals, and drawing down grant funds for Reserve operations. The Department of Natural Resources provides legal and legislative services to all its line offices such as the Reserve. The Reserve compensates for external administrative support through direct charges to NERR operations grants. To the extent practical, external support will be accounted for through applications for NERRS operations funding. The ODW maintains a comprehensive management system for tracking the allocation of employees' time and for documenting ODW assistance for Reserve activities.

## **Division of Wildlife administrative support for the OWC NERR**

### Wildlife Management and Research Executive Administrator

- Administrative oversight
- Policy coordination
- Budget planning

### Wildlife Management Research Coordinator

- Administrative oversight
- Policy development and coordination
- Budget development and planning
- Coordinates Research activities and ensures consistency with ODW policies and strategic direction
- Supervises Reserve Manager

### Wildlife Business Group

- NERRS grants financial recordkeeping and reporting
- NERRS grant reimbursement for Reserve activities
- Accounts payable processing
- Donations processing
- Contract development and processing
- Inventory control
- Coordinates land acquisition activities

### Wildlife Human Resources and Planning

- Coordinates Reserve personnel actions
- Payroll and benefits administration
- Strategic planning and coordination of ODW comprehensive management system
- Oversight of grant progress reporting

### Wildlife District 2 (Findlay, OH)

- Coordinates law enforcement within the Reserve
- Assists with land management projects (e.g., controlled burning, aquatic invasive plant treatment) as requested

## **Federal Partner: U.S. Department of Commerce/NOAA/NOS/OCRM/ERD**

ERD has the primary responsibility within NOAA for administering the NERRS. All

Reserve sites go through a formal designation process. ERD provides oversight for the nation's reserves, as well as funding for program and facility development, operations, research, monitoring, education, and land acquisition. The NERRS operates as a federal/state partnership. Although the management of the Reserve, including development of site-specific policies, is Ohio's responsibility, NOAA provides overall system policies and guidelines, cooperates with and assists the state, and reviews its program regularly.

NOAA staff, in particular the program specialist for a state's reserve, communicates directly and regularly with state reserve staff. Regular communication aids both federal and state staff, and familiarizes both NOAA and state personnel with reserve management procedures and policies.

NOAA provides funding for the implementation of each Reserve's federally approved management plan. For each grant, performance reports, financial reports, and final reports are required. NOAA personnel carefully review the grant reports and associated communications to ensure compliance with program policies, specific grant conditions, and the achievement of grant objectives.

Pursuant to the CZMA, the OWC NERR is periodically evaluated by NOAA for its performance. The purpose of the NOAA review is to ensure that a state is complying with federal NERR goals, approved work plans, and its management plan. The 2009 NOAA evaluation of the OWC NERR is included in Appendix Q. Recommendations from that evaluation have been incorporated into this Management Plan.

## **Administrative Plan of OWC NERR**

The action plan on the following pages describes administrative actions that will support program implementation of the OWC NERR. The Reserve will operate cooperatively with other agencies and organizations in the region to achieve the goals, objectives, and actions outlined herein.

<p align="center"><b>VISION: OWC NERR is a regional leader in the stewardship and conservation of a Great Lakes coastal wetland ecosystem</b></p> <p align="center"><b>Mission: Improving the understanding, stewardship, and appreciation of Great Lakes estuaries and coastal wetland ecosystems</b></p>			
GOAL	OBJECTIVES	ACTIONS	PROGRAM AREAS
<b>Foster connections to the Old Woman Creek estuary and other coastal ecosystems</b>	A networked organizational framework with sufficient staffing and other resources facilitates the attainment of Reserve goals and objectives	Coordinate administrative aspects of volunteer service	A
	Volunteer service on behalf of the Reserve increases by 30%	Recruit volunteers to support Reserve programs	A, E, S
		Engage the OWC NERR Advisory Council in planning for implementation of management plan actions	A, E, R, S
	Students are attracted to coastal resource management professions	Provide shadowing and internship opportunities for students	A, E, R, S
	The Reserve's learning environment and the experiences of visitors and users are enhanced	Provide oversight for visitor center and exhibit renovation	A
		Facilitate master plan for Reserve that addresses program facility/space requirements and provides a roadmap to buildout	A
<b>Maintain effective and professional program operations</b>	Reserve science and technical expertise is transferred to estuarine stakeholders	Provide advisory service to coastal resource management agencies and programs	A, E, R, S
	A networked organization with sufficient capacity to meet program goals and objectives	Maintain existing and develop new program and administrative partnerships	A, E, R, S
		Secure grant funding from multiple sources to augment Reserve programs	A
		Fund staff positions and secure funding for staff opportunities	A,E
		Provide professional development and skill enrichment for Reserve staff	A
		Integrate management plan goals and objectives into state of Ohio performance evaluation system	A
		Participate and encourage staff participation in NERRS workgroups and committees	A
		Implement required and/or suggested actions that come from NOAA program evaluations	A
		Oversee maintenance of Reserve facilities and public access areas	A
<b>Enhance the OWC NERR's role as a regional focal point for wetland stewardship science, practice implementation, and education</b>	Buffer lands and waters are protected through the Reserve's land conservation strategy	Maintain landowner contacts and secure grant funding to conserve prioritized lands and waters in the Old Woman Creek watershed when opportunities arise	A, S

Program Area Key:  
 A - Administration  
 E - Education  
 R - Research  
 S - Stewardship

## **Administrative Partnerships of the OWC Reserve**

From its establishment in 1980, the Reserve has benefited from several integral citizen, state and local government partners. Although the scope of this document prevents listing them all, the following partners have consistently supported the OWC NERR and enabled it to accomplish its tasks.

### **The OWC NERR Advisory Council**

Creation of the OWC NERR Advisory Council (AC) was identified in the final Environmental Impact Statement (EIS) for the Reserve. The OWC AC is appointed by the director of ODNR to advise the Chief of the Division of Wildlife in the preparation and implementation of specific plans concerning this Reserve. The AC adopted bylaws to help conduct its business in 1982. These bylaws were subsequently amended in 2003 and 2005 (Current edition of AC bylaws in Appendix P). Following the 2005 bylaw amendment, the OWC NERR AC is composed of at least nine members that comprise the following groups with an interest in the Reserve program:

- At least one representative of a local government agency
- At least one representative of a local conservation group
- At least one representative of an Ohio or national conservation group
- At least one representative of a local agricultural group
- At least one representative of a local civic group
- At least one representative of a local or regional economic development group
- At least one representative of an Ohio educational institution
- At least one representative of a Great Lakes research institution
- At least one local landowner

Members are appointed to staggered three-year terms, and may be reappointed to consecutive terms. The council chooses a chairperson and vice-chairperson and may form and disband committees as the majority may desire. Special Council and committee meetings may be called, as deemed necessary. Reserve and other ODW staff provide the Council with reports and data relating to Reserve management, education, and research activities for the period between each meeting. The Council advises the Reserve manager and Chief of the Division of Wildlife in writing of any recommendations resulting from each meeting. The Council members represent the Reserve and solicit support for OWC Programs from outside agencies, educational institutions, legislators, and the public, and assist Reserve staff during conferences and other public events.

### **The Friends of OWC**

The not-for-profit Friends of OWC organized in 1998. The Friends promotes public awareness and appreciation of the uniqueness of the estuary and supports stewardship programs that help to sustain the ecological integrity of the estuary. The group assists the Reserve in carrying out education and training programs and takes a role in stewardship of the estuary by sponsoring the OWC watershed coordinator.

### **ODNR - Office of Coastal Management**

The ODNR created the Office of Coastal Management in 2002, now located in Sandusky. The Office of Coastal Management (OCM) is the lead agency in a cooperative effort by state agencies, political subdivisions and local groups to manage coastal resources, monitor activities that affect the resources, and foster the sustainable use of natural resources for the benefit of all citizens. The OCM program is supportive of, recognizes, and reinforces the goals of the OWC NERR. For instance, the Reserve boundaries lie entirely within Ohio's designated coastal zone; and within ODNR, a strong institutional relationship exists, as OCM and OWC NERR participate in interdisciplinary environmental reviews, nonpoint pollution management, coastal wetlands research and wetlands protection policies. Further, the OCM is an integral Reserve partner in the Ohio Coastal Training Program. Reserve staff assists the OCM with grant proposal review, project management and administration, and participates in the integrated management team structure of Ohio's coastal management program. OCM is represented on the OWC NERR Advisory Council in an ex-officio capacity.

### **Ohio Sea Grant College Program, Ohio State University**

The Ohio Sea Grant College Program (OSGCP) is one of 32 Sea Grant programs in the National Sea Grant College Program of NOAA. Every coastal state, as well as every Great Lakes state, has a Sea Grant Program. Matching funds for Ohio's Sea Grant are provided through a line item in the budget of the Ohio Board of Regents, the Ohio State University, private businesses and individuals, and by the home institution of scientists receiving grants from Ohio Sea Grant. The Ohio State University extension system provides outreach support for the Program through affiliated agents that are regionally located across the Lake Erie coast. The Franz Theodore Stone Laboratory on Gibraltar Island near Put-in-Bay, the nation's oldest freshwater biological field station, serves as the research, education, and outreach facility for the OSGCP. The OSGCP has collaborated extensively with the Reserve in outreach activities such as Stone Laboratory summer session classes and through its commitment to the Ohio Coastal Training Program partnership. The Director of the Ohio Sea Grant College Program and Stone Laboratory serves as a voting member of the OWC NERR Advisory Council.

### **Erie Soil and Water Conservation District**

The Erie Soil and Water Conservation District (Erie SWCD) became the 84th District in Ohio in 1953, established for the purpose of protecting, preserving, and restoring the natural resources in our area. The District was organized under the Ohio Revised Code section 1515, and is governed by a board of five supervisors, elected by the landowners of Erie County, with each supervisor serving a three-year term. Erie County, one of nine coastal counties adjacent to Lake Erie, is comprised of approximately 169,000 acres. The main objectives of the Erie SWCD are to minimize or prevent soil erosion, improve the water quality of our rivers, lakes, streams and groundwater supply, and restore or preserve valuable wildlife habitat. This is accomplished through the various programs that promote the wise use of agricultural and urbanizing lands.

Erie SWCD has routinely assisted the Reserve by promoting stewardship principles to landowners and leading stream/wetland restoration projects in the OWC watershed.

Through a recently-executed MOU between the Division of Wildlife and Erie SWCD (Appendix W), a watershed program will become part of the NERR program in Ohio. Erie SWCD employs the coordinator for the OWC watershed, who will take a collaborative role in all Reserve stewardship projects, within the Reserve, its watershed, and similar Lake Erie tributaries in the region.

### **Lake Erie Commission**

The Ohio Lake Erie Commission is made up of the directors of the Ohio Departments of Agriculture, Development, Health, Natural Resources and Transportation, as well as the Ohio Environmental Protection Agency. The mission of the Ohio Lake Erie Commission is to preserve Lake Erie's natural resources, protect the ecological quality of its watershed, and to promote economic development on the North Coast. This is accomplished through implementation of policies and programs of state government pertaining to such matters as water quality, habitat, recreation and tourism and resource management within the Lake Erie basin. These policies are implemented directly by the Ohio Lake Erie Commission and by its member state agencies. A significant role of the Commission is to ensure the coordination of policies and programs of state government pertaining to water quality, toxic substances, and coastal resource management. The Commission also oversees the Lake Erie Protection Fund which provides grants to public sector, academic and non-profit organizations for the protection and restoration of Lake Erie resources. Education and promotion of the importance of Lake Erie is the goal of the Commission public outreach activities. The Reserve supports the Commission's commitment to Lake Erie basin balanced growth watershed plans and collaborates with Lake Erie Commission on regional research and training as well as coastal resource stewardship projects. For instance, in 2008, the Lake Erie Commission became a core partner in the Ohio Coastal Training Program.

### **Reserve Program Staff**

The Reserve is more than its natural resources. The Program itself, as well as the implementation of this management plan, depends upon the skills, resourcefulness, and creativity of its staff members.

The OWC NERR staff includes a Reserve Manager, Research, Education, and CTP Coordinators, and several part-time staff, including an Administrative Assistant, who also coordinates Reserve volunteer activities. All Reserve staff members are employees of the ODW. In addition, Reserve administration and programs are implemented through the assistance of several part-time staff designated to assist with particular program areas. The Reserve's networked approach to stewardship relies on the technical assistance of the watershed program coordinator for restoration projects within the boundary of the Reserve and implementation of practices upstream in the watershed.



### **Reserve Manager (1 FTE)**

- Facilitates the development of the mission, goals and objectives of the Reserve and directs their achievement
- Secures NOAA/NERRS, other federal, state, and private funding to implement operational elements of this management plan
- Directs the day-to-day operation of the OWC NERR Program under the policy direction of the Wildlife Management and Research section of the ODW
- Serves as the Reserve point-of-contact and ambassador within the ODW
- Responsible for program for and administration of state and federal grants, contracts and budget appropriations for the Reserve, including applications, determination of expenditures, performance reports and annual reports
- Directs the operation and maintenance of visitor center, research laboratories, classrooms, administrative offices, dormitory, maintenance and storage facilities
- Provides oversight, supervision and coordination of the Reserve's research, monitoring, education, outreach and stewardship programs and staff
- Serves as liaison to local, state and federal agencies, advisory councils and other interested groups to improve cooperation and coordination in management of the Reserve
- Represents OWC NERR and the ODW at state, regional and national NOAA, OCRM, NERRS and CZM program meetings, conferences and symposia
- Recruits, supervises, and evaluates Reserve staff
- Assumes principle responsibility for preparation and implementation of the Reserve's management plan
- Receives and acts on program input and recommendations from the OWC NERR Advisory Council and other stakeholder groups
- Coordinates land management activities
- Coordinates law enforcement with ODNR and ODW law enforcement officers

### **Reserve Research Coordinator (1 FTE)**

- Coordinates research activities at the Reserve and develops; and maintains working relationships with other research institutions, laboratories, universities, and related organizations
- Communicates with ODW and other ODNR resource managers to identify relevant coastal wetland research topics and questions
- Promotes use of the Reserve for research activities by researchers; disseminates information about research and funding opportunities at the Reserve
- Conducts and/or coordinates monitoring activities such as SWMP and other monitoring efforts as outlined by OWC NERR Management Plan
- Advises Reserve Manager as to compliance with NERRS monitoring performance standards
- Develops and documents monitoring protocols
- Maintains Reserve research and monitoring databases
- Coordinates the use of state and federal research support funds for the Reserve

### **Reserve Research Coordinator (con't.)**

- Works with researchers in developing articles for scientific journals, technical reports, and technical bulletins
- Disseminates information about the Reserve's research and monitoring activities.
- Responds to agency and public requests for information and technical assistance
- Reviews and critiques research proposals for studies at OWC and at other sites as requested
- Collaborates with Reserve staff in developing and implementing educational materials and activities addressing the management implications of current and past research
- Develops and presents research transfer programs and seminars as requested
- Represents OWC NERR and ODW at regional and national NOAA, NERRS and CZM researcher meetings, and conferences
- Represents regional perspective as part of NERRS research program development
- Trains research staff and interns, as available
- Maintains on-site scientific equipment
- Develops education program budget for Reserve Manager approval
- Advises Reserve Manager as to program funding needs and makes grant recommendations
- Recommends enhancements to scientific and technical holdings in Reserve library. Provides to Reserve library, theses and final reports of research conducted at OWC

### **Reserve Education Coordinator (1 FTE)**

- Develops, coordinates & conducts estuarine & stewardship education program components for K-12 and community audiences
- Develops and disseminates educational materials and resources related to the OWC NERR, including information linking research and education with priority audiences
- Oversees the correlation of Reserve education curriculum and programs to Ohio state content standards
- Facilitates staff input into the development of interpretive exhibits and materials about the Reserve the OWC estuary, and ODW
- Represents OWC NERR and ODNR at regional and national NOAA, OCRM, NERRS and CZM educators meetings, conferences and symposia
- Works with Reserve Manager and Research Coordinator in developing and implementing educational initiatives which further the goals of the Reserve Management plan relating to K-12 and community audiences
- Works with the Reserve Manager to implement Reserve management plan education actions
- Advises Reserve Manager as to Reserve education performance measures
- Collaborates with Reserve staff to interpret management implications of estuarine research
- Coordinates OWC NERR involvement in regional education partnerships

### **Reserve Education Coordinator (con't.)**

- Represents OWC NERR and ODNR at regional and national NOAA, OCRM, NERRS and CZM educators meetings, conferences and symposia
- Represents regional perspective as part of NERRS CTP development
- Maintains Reserve education equipment
- Recommends information and reference additions to the Reserve library
- Prepares and distributes media information about the Reserve's programs

### **Reserve Coastal Training Program Coordinator/Communications Specialist (1 FTE)**

- Develops, supervises and conducts educational programs for local and regional officials and other strategic audiences
- Develops and disseminates educational materials and resources related to the OWC NERR, including information linking research and education with the coastal decision-making community
- Participates in the development of interpretive exhibits and materials about the Reserve the OWC estuary, and ODW
- Represents OWC NERR and ODNR at regional and national NOAA, OCRM, NERRS and CZM educators meetings, conferences and symposia
- Works with Reserve Manager and Research Coordinator in developing and implementing educational initiatives which further the goals of the Reserve Management plan relating to prioritized training audiences
- Works with the Reserve Manager in implementing Reserve management plan education actions
- Advises Reserve Manager as to Reserve coastal training program compliance with NOAA performance metrics
- Develops outreach partnerships within the ODNR and among other resource management agencies
- Collaborates with Reserve staff to interpret management implications of estuarine research
- Represents OWC NERR and ODNR at regional and national NOAA, OCRM, NERRS and CZM educators meetings, conferences and symposia
- Represents regional perspective as part of NERRS CTP development
- Maintains Reserve education equipment
- Develop education program budget for Reserve manager approval
- Advise Reserve Manager as to program funding needs and make grant recommendations
- Recommends information and reference additions to the Reserve library
- Acts as content manager for OWC NERR websites
- Prepares and distributes media information about the Reserve's programs

### **Reserve Administrative Assistant/Volunteer Coordinator (.5 FTE)**

- Serves as staff liaison to ODW business and human resource sections
- Assists Reserve Manager and other staff in executing purchases and developing contracts
- Prepares all payroll information
- Reconciles all accounts payable information
- Prepares budget reports
- Maintains fiscal and personnel records
- Assists with Reserve inventory survey and control
- Assists with the operation of all Reserve facilities (e.g., is point of contact for contractors such as custodial and aquarium service)
- Researches & analyzes materials, information, and programs
- Makes recommendations and assists in developing new procedures and programs
- Assumes responsibility and authority in Reserve Manager's absence
- Coordinates all scheduling of Reserve program volunteers and administers their service

### **Seasonal and Part-Time Staff**

#### **Reserve K – 12 and Community Education Assistant (.5 FTE)**

- Assists Reserve education Staff
- Develops interpretive, educational and informative materials that further the goals of the Reserve management plan
- Prepares and delivers presentations to various classes, public, and community groups
- Delivers “train the trainer” workshops for regional educators
- Assists with the development of seminars, workshops, and symposia designed to transfer information to estuarine and coastal managers

#### **Reserve Facilities and Equipment Maintenance Specialist (.5 FTE)**

- Performs preventive maintenance and minor repairs to HVAC systems, hot water heaters, and other equipment in the Reserve Visitor/Research center, dormitories, boat house, storage facilities and shop
- Performs semi-skilled plumbing, electrical and carpentry duties involving minor installation, maintenance, or repairs of buildings, equipment (faucets, toilets, showers, ballasts, lights, switches, doors, windows, furniture), roofs and siding, gutters and downspouts, interior and exterior painting
- Performs seasonal landscaping and habitat care tasks, as needed.
- Assists Reserve staff with other tasks, as assigned by Reserve Manager

#### **Reserve Office Assistant (.5 FTE)**

- Computer data entry (e.g., SWMP and site monitoring data)
- Technical writing; proofreading, editing, preparing reports, correspondence, procedural manuals
- Organizes and maintains project files
- Records proceedings of meetings-

### **Reserve Lab Technicians (2-Part-time) (1 FTE)**

- Assist with the processing and analysis of samples from SWMP and Reserve site-specific monitoring programs
- Perform routine calibration of equipment such as data sondes
- Assist with Reserve water quality research, as time permits

### **Seasonal Naturalist (.25 FTE)**

- Assist Reserve education staff with community and K-12 programming for a term beginning each June and ending the following September

### **Adjunct Staff**

#### **ODW Wildlife Biologist (Wind Energy initiative) (.2 FTE)**

- Assist Reserve with spatial analysis and the development of GIS products
- Assist with the development of ODNR policies relating to wind turbines
- Collaborate with wind energy development interests to provide adequate pre- and post-construction monitoring of wind turbines in the Lake Erie watershed
- Assists Reserve researchers and staff with avian monitoring/surveying
- Coordinate Lake Erie basin research relating to wind energy

#### **OWC Watershed Coordinator (Erie SWCD, 1 FTE)**

- Develop a sustainable watershed group for OWC
- Coordinate a local partnership effort to develop and implement a watershed action plan for OWC
- Partner with Reserve staff on watershed education and training topics
- Lead a volunteer monitoring effort in the OWC watershed

### **Future Staffing Considerations**

The Reserve has benefited from the efforts and skills of a talented, dedicated staff for many years. Several staff members began their service at the Reserve as volunteers. One of the necessary actions for the Reserve in the short and longer term is to prepare for transition due to retirements and attrition. This necessitates evaluating the options that can create an efficient, sustainable staffing scenario for the OWC NERR and may involve some reconfiguration of duties from the existing organization and assignments. In 2004, the Reserve hired a project employee assistant manager to work with the out-going Reserve Manager prior to his retirement. For other positions, if feasible, overlapping the outgoing and incoming staff for mentoring purposes would well serve the Reserve and set the new staff member up for success.

As funding becomes available, the Reserve will prioritize the development of the following staff positions. This would fulfill recommendations of NOAA made in previous program evaluations of the OWC NERR:

**Full time lab technician/research assistant (1 FTE)**

This staff person would have responsibility for collecting, processing, and analyzing SWMP water quality and climate data and provide assistance with Reserve initiated or partner research would be as time permits. The Reserve currently relies heavily on the Research Coordinator and part-time laboratory assistants to meet data collection needs of the SWMP and site-based water quality monitoring program. A full-time monitoring assistant could reduce demands on the Research Coordinator for direct laboratory work. The hiring of a full time lab technician has been a recommendation of previous OWC NERR program evaluations.



OWC NERR volunteers assemble a boardwalk section

## **Reserve Volunteers**

Program volunteers have been an integral part of the OWC NERR since 1982. Volunteers receive classroom training and on-the-job experience with Reserve staff members before working independently with the public by themselves. In-service training is provided by the Reserve each year and field trips or other special training for all volunteers are offered during winter and early spring months. Printed materials have been developed for use in the orientation and training sessions. The Reserve Administrative Assistant coordinates the administration of volunteer staff for Visitor Center duty. The Administrative Assistant also works with the Reserve Manager and Education Programs Coordinator to provide volunteer staff for special projects.

During the implementation period of the previous OWC NERR management plan, construction on the third phase of the DeWine Center necessitated closing the exhibit hall to visitors for an extended period. During that period, there was no need for information desk assistance in the Center, so the volunteer program went through a period of attrition. The Reserve will continue to enhance volunteerism at the Reserve throughout this management plan cycle through continuous recruitment and keeping an emphasis on defining volunteer opportunities that suit a variety of skills, age, and level of time commitment. To accomplish more citizen engagement in the Reserve, all program areas will seek to take advantage of the following volunteer service opportunities:

- Active recruitment of citizen groups, youth organizations, and service learning opportunity seekers
- Participating in Ohio Volunteer Naturalist Program
- Providing volunteer information to new area residents
- Incorporating volunteer opportunities in all Reserve education and outreach programs
- Gearing opportunities to the unique talents and interests of prospective volunteers
- Maintaining a mix of recurring opportunities with one-time service events to better align volunteer choices with people's hectic schedules





Autumn along the OWC NERR early succession trail section

## **Chapter 7. Public Access**

The Reserve views public access to the estuary to be critical to developing public support and promoting stewardship. Located three miles west of the city of Huron, on the north shore of Ohio midway between Toledo and Cleveland, the Reserve is centrally located and ideally situated to be a regional focal point for stewardship education. Area tourist attractions bring an additional six million people into Erie County between the months of May to the end of October. Pertaining to local watershed residents, the NOAA Coastal Service Center social assessment of the OWC watershed showed that there are a high percentage of residents that commute to their work in Cleveland or Toledo (Appendix I). Evening events seem to be better attended when the watershed is the target audience. This necessitates that the Reserve consider the best times and times of year to attract specific audiences to programs and events.

Even a casual visit to the Reserve should result in increased understanding of the importance and complexity of, and the consequences of human impacts on Great Lakes estuaries. This responsibility does require a focus on education, so that sensitive areas of the Reserve are not disturbed and are available for scientific discovery.

### **Public Access Plan of OWC NERR**

The action plan on the following page describes public access-oriented actions that promote stewardship of the OWC NERR. The Reserve will work cooperatively with other agencies and organizations in the region to achieve the goals, objectives, and actions outlined herein.

<p><i>Vision: OWC NERR is a regional leader in the stewardship and conservation of a Great Lakes coastal wetland ecosystem</i></p> <p><b>Mission: Improving the understanding, stewardship, and appreciation of Great Lakes estuaries and coastal wetland ecosystems</b></p>			
GOAL	OBJECTIVES	ACTIONS	PROGRAM AREAS
<p><b>Foster connections to the Old Woman Creek estuary and other coastal ecosystems</b></p>	<p>The Reserve's learning environment and the experiences of visitors and users are enhanced</p>	<p>Improve and maintain trails in and around the DeWine Center</p>	<p>A, S</p>
		<p>Provide canoe/kayak access within Reserve boundaries consistent with state nature preserve access regulations</p>	<p>A</p>
		<p>Identify options for additional low impact access to the estuary through a master planning process</p>	<p>A, E, R, S</p>

Program Area Key:  
 A - Administration  
 E - Education  
 R - Research  
 S - Stewardship

## Policies for Access to the OWC Reserve

This management plan sets forth the intent and actions for maintaining the lands and waters of the Reserve as a stable platform for research, monitoring, and education activities. Because the Reserve is a designated State Nature Preserve, adequate regulatory protections exist within state codes to ensure that the Reserve meets its intended use into perpetuity. The State Nature Preserve also incorporates rules governing preserves that address user conflicts or degradation of the estuary's resources (ORC 1517; in Appendix C). The lands and waters of the 573-acre state nature preserve constitute the Reserve. In the event of additional land conservation in the OWC watershed, traditional activities and uses (e.g., hunting, fishing) on lands beyond the state nature preserve could be allowable in accordance with other state laws.

Public access to the Reserve is encouraged to the extent that such access is not a detriment to Reserve natural and cultural resources and does not interfere with the Reserve program of research and education. Reserve policies and rules relating to public access has stewardship implications for two primary reasons:

- For people to be good stewards, they must grow in appreciation of the estuary and its resources.
- The Reserve is committed to public access while protecting its sensitive resources.

The following list includes some activities that may be permitted in the Reserve with prior approval through consultation with Reserve and/or other Division of Wildlife staff:

- field research
- species collection (animals or plants)
- off-trail access for low impact purposes (e.g., art, photography)
- watercraft use within Reserve boundaries
- participation in controlled deer hunts

A particularly popular type of water-borne access to the Reserve is via canoe or kayak. In instances where there is no interference with Reserve research and monitoring activities, canoeing is allowed by permit issued by Reserve staff. To clarify the conditions under which canoeing is permitted, the Reserve has established the following canoe policy:

- Permits to canoe the estuary may be used between the hours of 8 a.m. to 5 p.m.
- All water access to the Reserve must be consistent with Ohio state nature preserve (ORC 1517) and Ohio watercraft (ORC 1547) regulations.
- Collecting, removing, or otherwise disturbing natural or historical features of the Reserve are not permitted
- Deployed research equipment and markers are not to be disturbed
- Permits will not be issued when estuarine water levels do not support watercraft use
- Paddlers must stay in main channel on the west side of Star Island

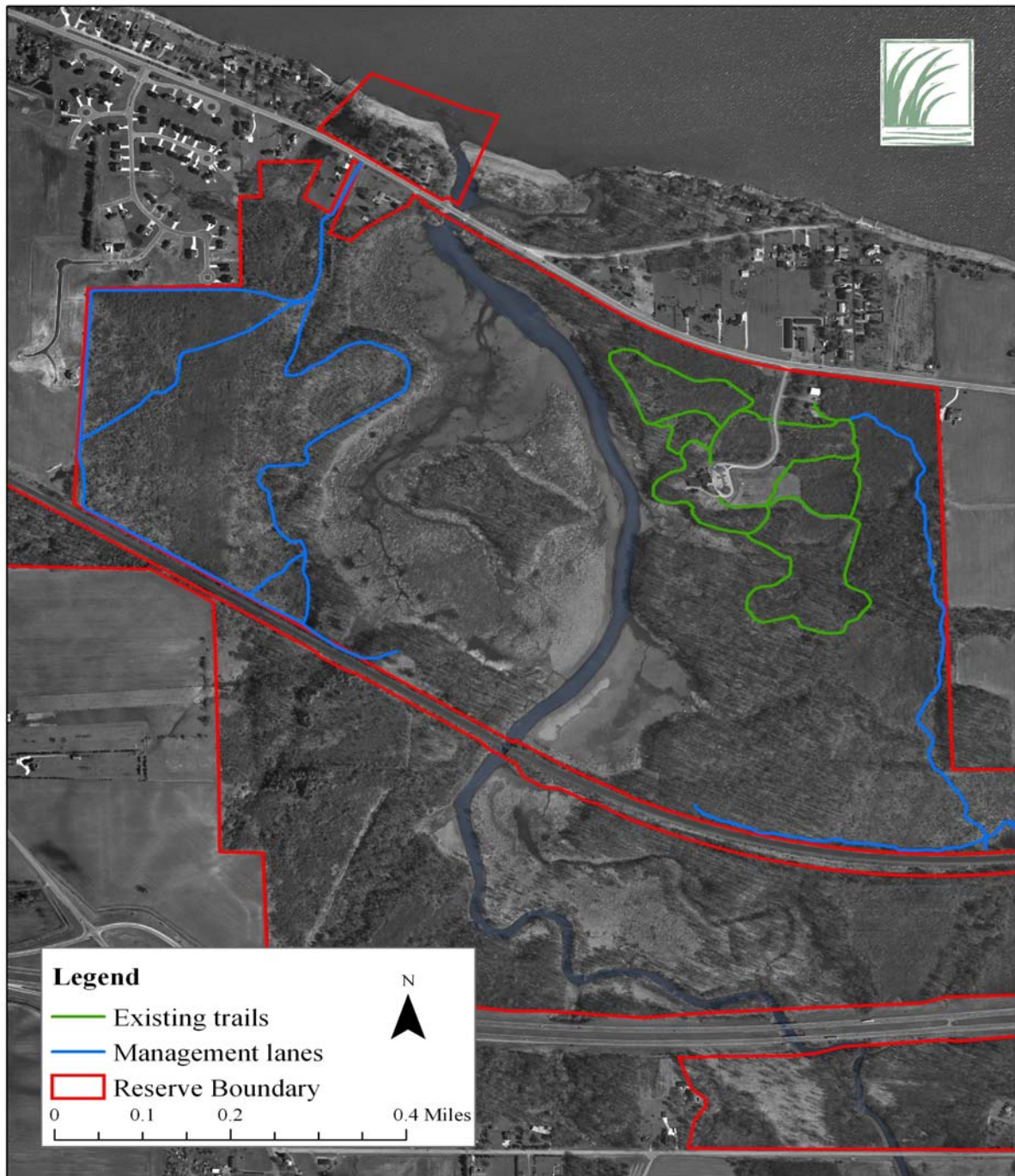
- Nesting bald eagles are not to be harassed. OWC NERR may find it necessary to provide additional guidance to watercraft travel within Reserve boundaries as part of special conditions associated with an access permit.

Anyone wishing to submit a permit application, with the exception of the controlled hunt permit, may contact the Reserve for more information.

### **Trail Expansion**

The Reserve will undertake a project to provide additional trail access in upland areas. Ultimately, these trails will connect to estuarine Lake Erie shoreline to provide additional vantage points of the estuary. The first phase of the project is to complete additional loops off the existing 1.4 mile trail network. Existing and planned trail loops are shown in Figure 16 on the following page. There are no plans currently to open the additional sections on the western branch of the estuary until a solution for parking vehicles is identified. Until then, the additional paths will aid research and resource management.

Figure 16. Trail expansion





OWC NERR water chemistry lab

## **Chapter 8. Facilities of the OWC NERR**

OWC NERR facilities enable the Reserve to function as a site-based research and education program. Specific planned actions related to facilities based on the needs of the Reserve's research, education, and stewardship programs.

### **Existing Facilities**

Reserve facilities include the DeWine Center for Coastal Wetland Studies (also known as the Visitor Center), two equipment barns, two dormitory buildings, and a maintenance workshop. The equipment pole barns and the workshop are shared facilities with the ODNR Division of Parks (Figure 17). The administrative offices of the Reserve are located in the DeWine Center for Coastal Wetland Studies. Housed within the DeWine Center are: visitor exhibits and displays, labs, classroom spaces, reference library, and storage areas. The building has evolved through three phases since its opening in 1982. The most recent addition opened to the public in 2003, and featuring recycled and recyclable products for much of the construction. From the building, trails wind through various habitats of the Reserve. The location of the buildings and facilities are shown in Figure 18.

### **Facilities Plan of OWC NERR**

The action plan on the following page describes actions that will support the development of new facilities as well as maintain existing Reserve facilities. The Reserve will operate cooperatively with other agencies and organizations in the region to implement the activities outlined in the action plan.



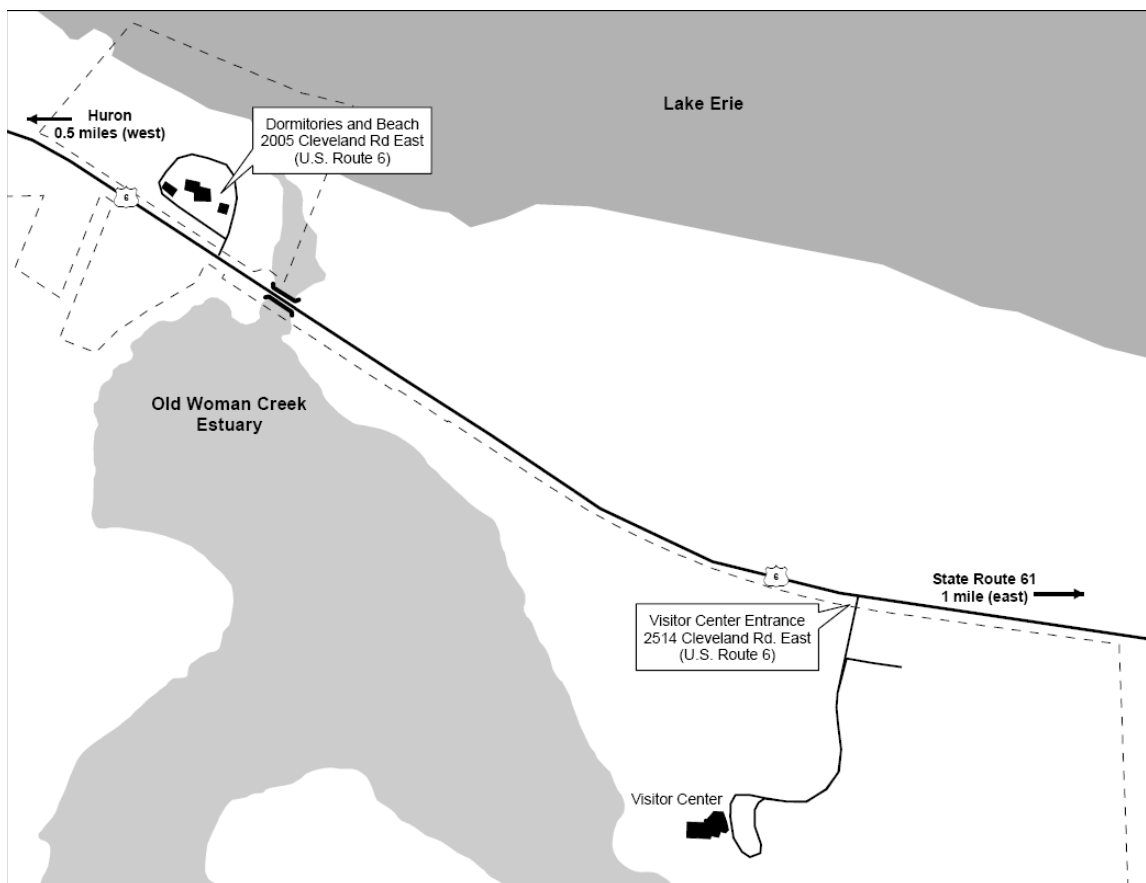
<b>VISION: OWC NERR is a regional leader in the stewardship and conservation of a Great Lakes coastal wetland ecosystem</b> <b>Mission: Improving the understanding, stewardship, and appreciation of Great Lakes estuaries and coastal wetland ecosystems</b>			
GOAL	OBJECTIVES	ACTIONS	PROGRAM AREAS
<b>Foster connections to the Old Woman Creek estuary and other coastal ecosystems</b>	The Reserve's learning environment and the experiences of visitors and users are enhanced	Renovate interpretive displays in the Reserve visitor center	A, E, R, S
		Improve trail signage for all trails and barrier beach access	A, E, S
		Create a more "visitor-friendly" front entrance	A, E
<b>Maintain effective and professional program operations</b>	A networked organization with sufficient capacity to meet program goals and objectives	Develop plans for facility upgrades and construction that provide a range of visitor services	A, E, R, S
		Maintain existing Reserve facilities as a safe, productive work environment	A
		Increase the energy efficiency of Reserve facilities	A

Program Area Key:  
 A - Administration  
 E - Education  
 R - Research  
 S - Stewardship

Figure 17. OWC NERR facility overview



**Figure 18. OWC NERR site locations**



## Research Spaces

The space devoted to laboratories functions effectively for OWC NERR to meet the needs of today's coastal wetland researchers. Because partnerships enhance the Reserve's research program, OWC NERR has many amenities to offer researchers including its on-site labs, boathouse with watercraft, dormitories, and its central location on the Lake Erie shore midway between Cleveland and Toledo. The chemistry lab is outfitted to reflect the importance of water quality monitoring in estuarine research. Equipment includes research grade microscopes, precision balances, an autoclave, incubator, waterbath, specialized water sampling equipment, data storage, meteorological instruments, and bench space.

Canoes, kayaks, sampling nets and other gear for research and field education use are stored in a boathouse. The Reserve provides two dormitory buildings. In 1987, the first dormitory was completed as a 1,700 square foot bunkhouse-style building. The bunkhouse offers sleeping and cooking accommodations for 16 people. In 2004, a second dormitory was constructed specifically to accommodate long-term stays. Each of the two suites in the second dormitory consists of two beds and bathroom.

In 2004, the NERRS developed a tool for conducting facility inventories. After surveying NERR sites, NERRS developed a “standard” Reserve profile based on a facility space inventory of the system’s Reserves. The table below compares OWC NERR research space with the “standard” Reserve.

Table 6. OWC NERR Research / Standard Reserve Space Comparison

	OWC NERR	“Standard” Reserve
Laboratory	1,389	2,453
Outside storage	934	1,317
Inside storage	200	428
Dorms	992	1,846
Total Net Square Feet, research	3,515	6,044

## Education Spaces

The classrooms at the OWC NERR are used for education programs, community meetings, and workshops for students, educators, natural resource professionals, and the public.

The Reserve will prioritize the development of its primary classroom space as a distance learning center (DL). The further use of DL technology would expand the accessibility of Reserve education programs to groups that are unable to participate in on-site field learning experiences.

The Reserve reference library contains numerous technical journals, field interpretation guides, reprints of research conducted at OWC NERR, and maps. Recommendations for additions to the library are made to the Reserve manager by the coordinators of the research and education programs. Reserve planned improvements for the library include: 1) scanning hard copy documents housed in the library; and 2) providing on-site access to electronic journals.

Table 7. OWC NERR Education / Standard Reserve Space Comparison

	OWC NERR	“Standard” Reserve
Reception/Exhibit area	1,744	2,061
Education offices	240	640
Classrooms	700	1,321
Library	260	306
Storage	165	253
Total Net Square Feet, education	3,109	4,281

## Administrative Spaces

**Table 8.** OWC NERR Administrative / Standard Reserve Space Comparison

	OWC NERR	“Standard” Reserve
Offices, conference room	890	2,925
Kitchen	0	376
Storage	1,373	1,206
Total Net Square Feet, administration	2,263	4,507

## Guiding Principles for Facility Development

The Reserve will plan enhancements to the facilities during the timeframe of this Management Plan. In preparation, Reserve staff has participated in a strategic exercise to assess current facilities and has developed the following guiding principles for facility construction and renovation.

- Use the holistic Leadership in Energy and Environmental Design (LEEDS) and the NERRS Sustainable Design guidelines as the basis for new construction
- Demonstrate “green” products in new construction where they ideally meet needs
- Use products and materials that increase overall energy efficiency
- Use due diligence to reduce the impact of construction to natural resources of the Reserve
- Evaluate potential products for their compatibility with Northwest Ohio environmental and weather conditions
- Where feasible, incorporate flexibility for multiple use into designs
- Evaluate potential products for their ease of maintenance
- Choose products that enhance staff productivity and visitor service
- Incorporate stewardship as the most critical concept in new designs and ensure that products and practices have educational potential as well as transferability for other users

## Priorities for facility development

With the exception of revising displays in the visitor center, no other construction is eminent so, no other plans have been developed at the development of this management plan. Fabrication and installation of the displays will require additional on-site meeting space that will accommodate larger meetings (e.g., CTP workshops). Currently, the exhibit space is flexible, and can be reconfigured for various purposes, such as workshops or for meetings. Displays that have been planned for installation are not expected to provide this flexibility, so meeting space needed to be planned and developed to accommodate larger on-site groups.

At present, Reserve administrative facilities (e.g., staff offices) and storage areas are near capacity. As funding becomes available, the Reserve will have a design for ultimate facility buildout that incorporates the following additional spaces.

**Large multi-purpose meeting room**

The capacity of the Reserve classroom is approximately 30 persons. For the Ohio CTP and other Reserve education programs to serve larger groups, an additional meeting room must be constructed on-site. Several possible locations exist near the DeWine Center where such an addition could be constructed, e.g., the barn area (refer again to Figure 17) or directly west of the Center near the estuary's eastern shoreline. The Reserve will identify the optimal location and develop a conceptual plan. Additional staff office space could also be included in the design.

**Wet lab/day use area for researchers**

Reserve researchers could benefit from the addition of a field/wet lab space equipped with stainless steel or plastic sinks and counters, ventilation system, elevated arc fault interrupt circuits, cabinet space, and a changing area/locker room. This facility could potentially be constructed near the DeWine Center or at the dormitory location (refer to Figure 18).

**Boat docking and equipment storage for Lake Erie access**

The Reserve has only shallow draft watercraft, which hinders staff from conducting nearshore Lake Erie research and observations. An alternative for lake access might be via a public boat ramp facility in the city of Huron, approximately one half mile west of the Reserve.

**Maintenance of facility, equipment, and public use areas**

The Reserve manager assumes responsibility for ensuring the routine maintenance of facilities at OWC NERR and for obtaining facility maintenance services. The facilities and equipment maintenance specialist, employed part-time, is the primary staff aid. Several aspects of facility maintenance, such as lawn, custodial, HVAC, and aquarium care are outsourced by contract in order to free Reserve staff for their primary program duties. Equipment used in these functions is maintained through an on-site schedule (Appendix R). In keeping with the spirit of cooperation outlined as part of the 2004 MOU between ODNR's divisions of Wildlife and Natural Areas, use of several equipment items, (e.g., tractors, snow blades) have been shared between the Reserve and the Natural Areas district office.

**Reference**

NOAA, National Estuarine Research Reserve System. 2004. *Standard Reserve* (guidance). 10 pp.

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## Appendices

- A. Code of Federal Regulations as published in Federal Register, Part V, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, 15 C.F.R. Part 921
- B. Memorandum of Understanding Between the National Oceanic and Atmospheric Administration and the Ohio Department of Natural Resources Division of Wildlife Detailing the State-Federal Roles in the Management of the Old Woman Creek National Estuarine Research Reserve, Approved, August 2010
- C. Ohio Revised Code (ORC) Chapter 1517 Laws for Nature Preserves, Scenic River Lands, and Natural Areas
- D. Ohio Revised Code (ORC) Chapter 1531, Wildlife Laws of Ohio
- E. Research Completed at Old Woman Creek National Estuarine Research Reserve, Huron, Ohio
- F. OWC NERR Research Activities – 2010
- G. OWC NERR Technical Report and Bulletin Series
- H. Species Recorded In and Around OWC NERR (Reprinted from Site Profile: Ecology of Old Woman Creek, Ohio)
- I. Social Assessment Report, OWC Watershed (Prepared by NOAA CSC)
- J. Ohio CTP Strategic Plan
- K. Ohio CTP Needs Assessment
- L. Resource Protection Policies and Statutory Authority for OWC NERR
- M. Restoration Plan, Darrow Road Floodplain
- N. Memorandum of Understanding – ODNR Divisions of Wildlife and Natural Areas
- O. Journal Entry Transfer of Management Responsibility for OWC State Nature Preserve
- P. OWC NERR Advisory Council By-laws, as amended, May 2005
- Q. Final Evaluation Findings for the State of Ohio's Old Woman Creek National Estuarine Research Reserve, September 2006 through October 2009, NOAA, Executive Summary
- R. Facilities Maintenance Checklist - DeWine Center for Coastal Wetlands, OWC NERR

## **Appendices – con't.**

- S. Mapping Land Use and Habitat Change in the NERRS: Standard Operating Procedures**
- T. Consistency determination, Ohio Office of Coastal Management, January, 2009**
- U. OWC NERR Visitor Center Display Design Concepts**
- V. Lake Erie Literacy Principles**
- W. Memorandum of Understanding, ODNR – Wildlife, on behalf of the Old Woman Creek National Estuarine Research Reserve and Erie Soil and Water Conservation District**
- X. Report on Public Comment Period, March – April, 2011**

**Old Woman Creek NERR  
Management Plan**

**APPENDIX A**

**Code of Federal Regulations Relating to the  
NERRS**

Code of Federal Regulations

**Title 15, Volume 3, Revised as of January 1, 2003**  
**From the U.S. Government Printing Office via GPO Access**  
*[CITE: 15CFR921]*

TITLE 15--COMMERCE AND FOREIGN TRADE

CHAPTER IX--NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION,  
DEPARTMENT OF COMMERCE

PART 921--NATIONAL ESTUARINE RESEARCH RESERVE SYSTEM  
REGULATIONS

**Subpart A--General**

[921.1 Mission, goals and general provisions.](#)

[921.2 Definitions.](#)

[921.3 National Estuarine Research Reserve System Biogeographic Classification Scheme and Estuarine Typologies.](#)

[921.4 Relationship to other provisions of the Coastal Zone Management Act and the Marine Protection, Research and Sanctuaries Act.](#)

**Subpart B--Site Selection, Post Site Selection and Management Plan Development**

[921.10 General.](#)

[921.11 Site selection and feasibility.](#)

[921.12 Post site selection.](#)

[921.13 Management plan and environmental impact statement development.](#)

**Subpart C--Acquisition, Development and Preparation of the Final Management Plan**

[921.20 General.](#)

[921.21 Initial acquisition and development awards.](#)

**Subpart D--Reserve Designation and Subsequent Operation**

[921.30 Designation of National Estuarine Research Reserves.](#)

[921.31 Supplemental acquisition and development awards.](#)

[921.32 Operation and management: Implementation of the management plan.](#)

[921.33 Boundary changes, amendments to the management plan, and addition of multiple-site components.](#)

**Subpart E--Ongoing Oversight, Performance Evaluation and Withdrawal of Designation**

[921.40 Ongoing oversight and evaluations of designated National Estuarine Research Reserves.](#)

[921.41 Withdrawal of designation.](#)

**Subpart F--Special Research Projects**

[921.50 General.](#)

[921.51 Estuarine research guidelines.](#)

[921.52 Promotion and coordination of estuarine research.](#)

**Subpart G--Special Monitoring Projects**

[921.60 General.](#)

**Subpart H--Special Interpretation and Education Projects**

[921.70 General.](#)

**Subpart I--General Financial Assistance Provisions**

[921.80 Application information.](#)

[921.81 Allowable costs.](#)

[921.82 Amendments to financial assistance awards.](#)

[Appendix I to Part 921--Biogeographic Classification Scheme](#)

[Appendix II to Part 921--Typology of National Estuarine Research Reserves](#)

Authority: Section 315 of the Coastal Zone Management Act, as amended (16 U.S.C. 1461).

*Source: 58 FR 38215, July 15, 1993, unless otherwise noted.*

**Sec. 921.1 Mission, goals and general provisions.**

(a) The mission of the National Estuarine Research Reserve Program is the establishment and management, through Federal-state cooperation, of a national system (National Estuarine Research Reserve System or System) of estuarine research reserves (National Estuarine Research Reserves or Reserves) representative of the various regions and estuarine types in the United States. National Estuarine Research Reserves are established to provide opportunities for long-term research, education, and interpretation.

(b) The goals of the Program are to:

1. Ensure a stable environment for research through long-term protection of National Estuarine Research Reserve resources;
2. Address coastal management issues identified as significant through coordinated estuarine research within the System;
3. Enhance public awareness and understanding of estuarine areas and provide suitable opportunities for public education and interpretation;
4. Promote Federal, state, public and private use of one or more Reserves within the System when such entities conduct estuarine research; and
5. Conduct and coordinate estuarine research within the System, gathering and making available information necessary for improved understanding and management of estuarine areas.

(c) National Estuarine Research Reserves shall be open to the public to the extent permitted under state and Federal law. Multiple uses are allowed to the degree compatible with each Reserve's overall purpose as provided in the management plan (see Sec. 921.13) and consistent with paragraphs (a) and (b) of this section. Use levels are set by the state where the Reserve is located and analyzed in the management plan. The Reserve management plan shall describe the uses and establish priorities among these uses. The plan shall identify uses requiring a state permit, as well as areas where uses are encouraged or prohibited. Consistent with resource protection and research objectives, public access and use may be restricted to certain areas or components within a Reserve.

(d) Habitat manipulation for research purposes is allowed consistent with the following limitations. Manipulative research activities must be specified in the management plan, be consistent with the mission and goals of the program (see paragraphs (a) and (b) of this section) and the goals and objectives set forth in the Reserve's management plan, and be limited in nature and extent to the minimum manipulative activity necessary to accomplish the stated research objective. Manipulative research activities with a significant or long-term impact on Reserve resources require the prior approval of the state and the National Oceanic and Atmospheric Administration (NOAA). Manipulative research activities which can reasonably be expected to have a significant adverse impact on the estuarine resources and habitat of a Reserve, such that the activities themselves or their resulting short- and long-term consequences compromise the representative character and integrity of a Reserve, are prohibited. Habitat manipulation for resource management purposes is prohibited except as specifically approved by NOAA as: (1) A

restoration activity consistent with paragraph (e) of this section; or (2) an activity necessary for the protection of public health or the preservation of other sensitive resources which have been listed or are eligible for protection under relevant Federal or state authority (e.g., threatened/endangered species or significant historical or cultural resources) or if the manipulative activity is a long-term pre-existing use (i.e., has occurred prior to designation) occurring in a buffer area. If habitat manipulation is determined to be necessary for the protection of public health, the preservation of sensitive resources, or if the manipulation is a long-term pre-existing use in a buffer area, then these activities shall be specified in the Reserve management plan in accordance with Sec. 921.13(a)(10) and shall be limited to the reasonable alternative which has the least adverse and shortest term impact on the representative and ecological integrity of the Reserve.

(e) Under the Act an area may be designated as an estuarine Reserve only if the area is a representative estuarine ecosystem that is suitable for long-term research. Many estuarine areas have undergone some ecological change as a result of human activities (e.g., hydrological changes, intentional/unintentional species composition changes--introduced and exotic species). In those areas proposed or designated as National Estuarine Research Reserves, such changes may have diminished the representative character and integrity of the site. Although restoration of degraded areas is not a primary purpose of the System, such activities may be permitted to improve the representative character and integrity of a Reserve. Restoration activities must be carefully planned and approved by NOAA through the Reserve management plan. Historical research may be necessary to determine the "natural" representative state of an estuarine area (i.e., an estuarine ecosystem minimally affected by human activity or influence). Frequently, restoration of a degraded estuarine area will provide an excellent opportunity for management oriented research.

(f) NOAA may provide financial assistance to coastal states, not to exceed, per Reserve, 50 percent of all actual costs or \$5 million whichever amount is less, to assist in the acquisition of land and waters, or interests therein. NOAA may provide financial assistance to coastal states not to exceed 70 percent of all actual costs for the management and operation of, the development and construction of facilities, and the conduct of educational or interpretive activities concerning Reserves (see subpart I). NOAA may provide financial assistance to any coastal state or public or private person, not to exceed 70 percent of all actual costs, to support research and monitoring within a Reserve. Notwithstanding any financial assistance limits established by this Part, when financial assistance is provided from amounts recovered as a result of damage to natural resources located in the coastal zone, such assistance may be used to pay 100 percent of all actual costs of activities carried out with this assistance, as long as such funds are available. Predesignation, acquisition and development, operation and management, special research and monitoring, and special education and interpretation awards are available under the National Estuarine Reserve Program. Predesignation awards are for site selection/feasibility, draft management plan preparation and conduct of basic characterization studies. Acquisition and development awards are intended primarily for acquisition of interests in land, facility construction and to develop and/or upgrade research, monitoring and education programs. Operation and management awards

provide funds to assist in implementing, operating and managing the administrative, and basic research, monitoring and education programs, outlined in the Reserve management plan. Special research and monitoring awards provide funds to conduct estuarine research and monitoring projects with the System. Special educational and interpretive awards provide funds to conduct estuarine educational and interpretive projects within the System.

(g) Lands already in protected status managed by other Federal agencies, state or local governments, or private organizations may be included within National Estuarine Research Reserves only if the managing entity commits to long-term management consistent with paragraphs (d) and (e) of this section in the Reserve management plan. Federal lands already in protected status may not comprise a majority of the key land and water areas of a Reserve (see Sec. 921.11(c)(3)).

(h) To assist the states in carrying out the Program's goals in an effective manner, NOAA will coordinate a research and education information exchange throughout the National Estuarine Research Reserve System. As part of this role, NOAA will ensure that information and ideas from one Reserve are made available to others in the System. The network will enable Reserves to exchange information and research data with each other, with universities engaged in estuarine research, and with Federal, state, and local agencies. NOAA's objective is a system-wide program of research and monitoring capable of addressing the management issues that affect long-term productivity of our Nation's estuaries.

*[58 FR 38215, July 15, 1993, as amended at 62 FR 12540, Mar. 17, 1997; 63 FR 26717, May 14, 1998].*



**Sec. 921.2 Definitions**

(a) Act means the Coastal Zone Management Act of 1972, as amended, 16 U.S.C. 1451 et seq.

(b) Assistant Administrator means the Assistant Administrator for Ocean Services and Coastal Zone Management or delegee.

(c) Coastal state means a state of the United States, in or bordering on, the Atlantic, Pacific, or Arctic Ocean, the Gulf of Mexico, Long Island Sound, or one or more of the Great Lakes. For the purposes of these regulations the term also includes Puerto Rico, the Virgin Islands, Guam, the Commonwealth of the Northern Marianas Islands, the Trust Territories of the Pacific Islands, and American Samoa (see 16 U.S.C. 1453(4)).

(d) State agency means an instrumentality of a coastal state to whom the coastal state has delegated the authority and responsibility for the creation and/or management/operation of a National Estuarine Research Reserve. Factors indicative of this authority may include the power to receive and expend funds on behalf of the Reserve, acquire and sell or convey real and personal property interests, adopt rules for the protection of the Reserve, enforce rules applicable to the Reserve, or develop and implement research and education programs for the reserve. For the purposes of these regulations, the terms "coastal state" and "State agency" shall be synonymous.

(e) Estuary means that part of a river or stream or other body of water having unimpaired connection with the open sea, where the sea water is measurably diluted with fresh water derived from land drainage. The term also includes estuary-type areas with measurable freshwater influence and having unimpaired connections with the open sea, and estuary-type areas of the Great Lakes and their connecting waters (see 16 U.S.C. 1453(7)).

(f) National Estuarine Research Reserve means an area that is a representative estuarine ecosystem suitable for long-term research, which may include all of the key land and water portion of an estuary, and adjacent transitional areas and uplands constituting to the extent feasible a natural unit, and which is set aside as a natural field laboratory to provide long-term opportunities for research, education, and interpretation on the ecological relationships within the area (see 16 U.S.C. 1453(8)) and meets the requirements of 16 U.S.C. 1461(b). This includes those areas designated as National Estuarine Sanctuaries or Reserves under section 315 of the Act prior to enactment of the Coastal Zone Act Reauthorization Amendments of 1990 and each area subsequently designated as a National Estuarine Research Reserve.

**Sec. 921.3 National Estuarine Research Reserve System Biogeographic Classification Scheme and Estuarine Typologies.**

(a) National Estuarine Research Reserves are chosen to reflect regional differences and to include a variety of ecosystem types. A biogeographic classification scheme based on regional variations in the nation's coastal zone has been developed. The biogeographic classification scheme is used to ensure that the National Estuarine Research Reserve System includes at least one site from each region. The estuarine typology system is utilized to ensure that sites in the System reflect the wide range of estuarine types within the United States.

(b) The biogeographic classification scheme, presented in appendix I, contains 29 regions. Figure 1 graphically depicts the biogeographic regions of the United States.

(c) The typology system is presented in appendix II..

**Sec. 921.4 Relationship to other provisions of the Coastal Zone Management Act, and to the Marine Protection, Research and Sanctuaries Act.**

(a) The National Estuarine Research Reserve System is intended to provide information to state agencies and other entities involved in addressing coastal management issues. Any coastal state, including those that do not have approved coastal management programs under section 306 of the Act, is eligible for an award under the National Estuarine Research Reserve Program (see Sec. 921.2(c)).

(b) For purposes of consistency review by states with a federally approved coastal management program, the designation of a National Estuarine Research Reserve is deemed to be a Federal activity, which, if directly affecting the state's coastal zone, must be undertaken in a manner consistent to the maximum extent practicable with the approved state coastal management program as provided by section 1456(c)(1) of the Act, and implementing regulations at 15 CFR part 930, subpart C. In accordance with section 1456(c)(1) of the Act and the applicable regulations NOAA will be responsible for certifying that designation of the Reserve is consistent with the state's approved coastal management program. The state must concur with or object to the certification. It is recommended that the lead state agency for Reserve designation consult, at the earliest practicable time, with the appropriate state officials concerning the consistency of a proposed National Estuarine Research Reserve.

(c) The National Estuarine Research Reserve Program will be administered in close coordination with the National Marine Sanctuary Program (Title III of the Marine Protection, Research and Sanctuaries Act, as amended, 16 U.S.C. 1431-1445), also administered by NOAA. Title III authorizes the Secretary of Commerce to designate discrete areas of the marine environment as National Marine Sanctuaries to protect or restore such areas for their conservation, recreational, ecological, historical, research,

educational or esthetic values. National Marine Sanctuaries and Estuarine Research Reserves may not overlap, but may be adjacent.

### **Sec. 921.10 General.**

(a) A coastal state may apply for Federal financial assistance for the purpose of site selection, preparation of documents specified in Sec. 921.13 (draft management plan (DMP) and environmental impact statement (EIS)), and the conduct of limited basic characterization studies. The total Federal share of this assistance may not exceed \$100,000. Federal financial assistance for preacquisition activities under Sec. 921.11 and Sec. 921.12 is subject to the total \$5 million for which each Reserve is eligible for land acquisition. Notwithstanding the above, when financial assistance is provided from amounts recovered as a result of damage to natural resources located in the coastal zone, such assistance may be used to pay 100 percent of all actual costs of activities carried out with this assistance, as long as such funds are available. In the case of a biogeographic region (see appendix I) shared by two or more coastal states, each state is eligible for Federal financial assistance to establish a separate National Estuarine Research Reserve within their respective portion of the shared biogeographic region. Each separate National Estuarine Research Reserve is eligible for the full complement of funding. Financial assistance application procedures are specified in subpart I.

(b) In developing a Reserve program, a state may choose to develop a multiple-site Reserve reflecting a diversity of habitats in a single biogeographic region. A multiple-site Reserve allows the state to develop complementary research and educational programs within the individual components of its multi-site Reserve. Multiple-site Reserves are treated as one Reserve in terms of financial assistance and development of an overall management framework and plan. Each individual site of a proposed multiple-site Reserve shall be evaluated both separately under Sec. 921.11(c) and collectively as part of the site selection process. A coastal state may propose to establish a multiple-site Reserve at the time of the initial site selection, or at any point in the development or operation of the Reserve. If the state decides to develop a multiple-site National Estuarine Research Reserve after the initial acquisition and development award is made for a single site, the proposal is subject to the requirements set forth in Sec. 921.33(b). However, a state may not propose to add one or more sites to an already designated Reserve if the operation and management of such Reserve has been found deficient and uncorrected or the research conducted is not consistent with the Estuarine Research Guidelines referenced in Sec. 921.51. In addition, Federal funds for the acquisition of a multiple-site Reserve remain limited to \$5,000,000 (see Sec. 921.20). The funding for operation of a multiple-site Reserve is limited to the maximum allowed for any one Reserve per year (see Sec. 921.32(c)) and preacquisition funds are limited to \$100,000 per Reserve. Notwithstanding the above, when financial assistance is provided from amounts recovered as a result of damage to natural resources located in the coastal zone, such assistance may be used to pay 100 percent of all actual costs of activities carrier out with this assistance, as long as such funds are available.

*[58 FR 38215, July 15, 1993, as amended at 63 FR 26717, May 14, 1998].*

**Sec. 921.11 Site selection and feasibility.**

(a) A coastal state may use Federal funds to establish and implement a site selection process which is approved by NOAA.

(b) In addition to the requirements set forth in subpart I, a request for Federal funds for site selection must contain the following programmatic information:

1. A description of the proposed site selection process and how it will be implemented in conformance with the biogeographic classification scheme and typology (Sec. 921.3);
2. An identification of the site selection agency and the potential management agency; and
3. A description of how public participation will be incorporated into the process (see Sec. 921.11(d)).

(c) As part of the site selection process, the state and NOAA shall evaluate and select the final site(s). NOAA has final authority in approving such sites. Site selection shall be guided by the following principles:

1. The site's contribution to the biogeographical and typological balance of the National Estuarine Research Reserve System. NOAA will give priority consideration to proposals to establish Reserves in biogeographic regions or subregions or incorporating types that are not represented in the system. (see the biogeographic classification scheme and typology set forth in Sec. 921.3 and appendices I and II);
2. The site's ecological characteristics, including its biological productivity, diversity of flora and fauna, and capacity to attract a broad range of research and educational interests. The proposed site must be a representative estuarine ecosystem and should, to the maximum extent possible, be an estuarine ecosystem minimally affected by human activity or influence (see Sec. 921.1(e)).
3. Assurance that the site's boundaries encompass an adequate portion of the key land and water areas of the natural system to approximate an ecological unit and to ensure effective conservation. Boundary size will vary greatly depending on the nature of the ecosystem. Reserve boundaries must encompass the area within which adequate control has or will be established by the managing entity over human activities occurring within the Reserve. Generally, Reserve boundaries will encompass two areas: Key land and water areas (or "core area") and a buffer zone. Key land and water areas and a buffer zone will likely require significantly different levels of control (see Sec. 921.13(a)(7)). The term "key land and water areas" refers to that core area within the Reserve that is so vital to the functioning of the estuarine ecosystem that it must be under a level of control sufficient to

- ensure the long-term viability of the Reserve for research on natural processes. Key land and water areas, which comprise the core area, are those ecological units of a natural estuarine system which preserve, for research purposes, a full range of significant physical, chemical and biological factors contributing to the diversity of fauna, flora and natural processes occurring within the estuary. The determination of which land and water areas are "key" to a particular Reserve must be based on specific scientific knowledge of the area. A basic principle to follow when deciding upon key land and water areas is that they should encompass resources representative of the total ecosystem, and which if compromised could endanger the research objectives of the Reserve. The term buffer zone refers to an area adjacent to or surrounding key land and water areas and essential to their integrity. Buffer zones protect the core area and provide additional protection for estuarine-dependent species, including those that are rare or endangered. When determined appropriate by the state and approved by NOAA, the buffer zone may also include an area necessary for facilities required for research and interpretation. Additionally, buffer zones should be established sufficient to accommodate a shift of the core area as a result of biological, ecological or geomorphological change which reasonably could be expected to occur. National Estuarine Research Reserves may include existing Federal or state lands already in a protected status where mutual benefit can be enhanced. However, NOAA will not approve a site for potential National Estuarine Research Reserve status that is dependent primarily upon the inclusion of currently protected Federal lands in order to meet the requirements for Reserve status (such as key land and water areas). Such lands generally will be included within a Reserve to serve as a buffer or for other ancillary purposes; and may be included, subject to NOAA approval, as a limited portion of the core area;
4. The site's suitability for long-term estuarine research, including ecological factors and proximity to existing research facilities and educational institutions;
  5. The site's compatibility with existing and potential land and water uses in contiguous areas as well as approved coastal and estuarine management plans; and
  6. The site's importance to education and interpretive efforts, consistent with the need for continued protection of the natural system.

(d) Early in the site selection process the state must seek the views of affected landowners, local governments, other state and Federal agencies and other parties who are interested in the area(s) being considered for selection as a potential National Estuarine Research Reserve. After the local government(s) and affected landowner(s) have been contacted, at least one public meeting shall be held in the vicinity of the proposed site. Notice of such a meeting, including the time, place, and relevant subject matter, shall be announced by the state through the area's principal newspaper at least 15 days prior to the date of the meeting and by NOAA in the Federal Register.

(e) A state request for NOAA approval of a proposed site (or sites in the case of a multi-site Reserve) must contain a description of the proposed site(s) in relationship to each of the site selection principals (Sec. 921.11(c)) and the following information:

1. An analysis of the proposed site(s) based on the biogeographical scheme/typology discussed in Sec. 921.3 and set forth in appendices I and II;
2. A description of the proposed site(s) and its (their) major resources, including location, proposed boundaries, and adjacent land uses. Maps are required;
3. A description of the public participation process used by the state to solicit the views of interested parties, a summary of comments, and, if interstate issues are involved, documentation that the Governor(s) of the other affected state(s) has been contacted. Copies of all correspondence, including contact letters to all affected landowners must be appended;
4. A list of all sites considered and a brief statement of the reasons why a site was not preferred; and
5. A nomination of the proposed site(s) for designation as a National Estuarine Research Reserve by the Governor of the coastal state in which the state is located.

(f) A state proposing to reactivate an inactive site, previously approved by NOAA for development as an Estuarine Sanctuary or Reserve, may apply for those funds remaining, if any, provided for site selection and feasibility (Sec. 921.11a)) to determine the feasibility of reactivation. This feasibility study must comply with the requirements set forth in Sec. 921.11 (c) through (e).

#### **Sec. 921.12 Post site selection.**

(a) At the time of the coastal state's request for NOAA approval of a proposed site, the state may submit a request for funds to develop the draft management plan and for preparation of the EIS. At this time, the state may also submit a request for the remainder of the predesignation funds to perform a limited basic characterization of the physical, chemical and biological characteristics of the site approved by NOAA necessary for providing EIS information to NOAA. The state's request for these post site selection funds must be accompanied by the information specified in subpart I and, for draft management plan development and EIS information collection, the following programmatic information:

1. A draft management plan outline (see Sec. 921.13(a) below); and
2. An outline of a draft memorandum of understanding (MOU) between the state and NOAA detailing the Federal-state role in Reserve management during the initial period of Federal funding and expressing the state's long-term commitment to operate and manage the Reserve.

(b) The state is eligible to use the funds referenced in Sec. 921.12(a) after the proposed site is approved by NOAA under the terms of Sec. 921.11.

### **Sec. 921.13 Management plan and environmental impact statement development.**

(a) After NOAA approves the state's proposed site and application for funds submitted pursuant to Sec. 921.12, the state may begin draft management plan development and the collection of information necessary for the preparation by NOAA of an EIS. The state shall develop a draft management plan, including an MOU. The plan shall set out in detail:

1. Reserve goals and objectives, management issues, and strategies or actions for meeting the goals and objectives;
2. An administrative plan including staff roles in administration, research, education/interpretation, and surveillance and enforcement;
3. A research plan, including a monitoring design;
4. An education/interpretive plan;
5. A plan for public access to the Reserve;
6. A construction plan, including a proposed construction schedule, general descriptions of proposed developments and general cost estimates. Information should be provided for proposed minor construction projects in sufficient detail to allow these projects to begin in the initial phase of acquisition and development. A categorical exclusion, environmental assessment, or EIS may be required prior to construction;
7. (i) An acquisition plan identifying the ecologically key land and water areas of the Reserve, ranking these areas according to their relative importance, and including a strategy for establishing adequate long-term state control over these areas sufficient to provide protection for Reserve resources to ensure a stable environment for research. This plan must include an identification of ownership within the proposed Reserve boundaries, including land already in the public domain; the method(s) of acquisition which the state proposes to use--acquisition (including less-than-fee simple options) to establish adequate long-term state control; an estimate of the fair market value of any property interest--which is proposed for acquisition; a schedule estimating the time required to complete the process of establishing adequate state control of the proposed research reserve; and a discussion of any anticipated problems. In selecting a preferred method(s) for establishing adequate state control over areas within the proposed boundaries of the Reserve, the state shall perform the following steps for each parcel determined to be part of the key land and water areas (control over which is necessary to protect the integrity of the Reserve for research purposes), and for those parcels required for research and interpretive support facilities or buffer purposes:
  - (A) Determine, with appropriate justification, the minimum level of control(s) required [e.g., management agreement, regulation, less-than-fee simple property interest (e.g., conservation easement), fee simple property acquisition, or a combination of these approaches]. This does not preclude the future necessity of increasing the level of state control;
  - (B) Identify the level of existing state control(s);
  - (C) Identify the level of additional state control(s), if any, necessary to meet the

minimum requirements identified in paragraph (a)(7)(i)(A) of this section; (D) Examine all reasonable alternatives for attaining the level of control identified in paragraph (a)(7)(i)(C) of this section, and perform a cost analysis of each; and (E) Rank, in order of cost, the methods (including acquisition) identified in paragraph (a)(7)(i)(D) of this section.

(ii) An assessment of the relative cost-effectiveness of control alternatives shall include a reasonable estimate of both short-term costs (e.g., acquisition of property interests, regulatory program development including associated enforcement costs, negotiation, adjudication, etc.) and long-term costs (e.g., monitoring, enforcement, adjudication, management and coordination). In selecting a preferred method(s) for establishing adequate state control over each parcel examined under the process described above, the state shall give priority consideration to the least costly method(s) of attaining the minimum level of long-term control required. Generally, with the possible exception of buffer areas required for support facilities, the level of control(s) required for buffer areas will be considerably less than that required for key land and water areas. This acquisition plan, after receiving the approval of NOAA, shall serve as a guide for negotiations with landowners. A final boundary for the reserve shall be delineated as a part of the final management plan;

8. A resource protection plan detailing applicable authorities, including allowable uses, uses requiring a permit and permit requirements, any restrictions on use of the research reserve, and a strategy for research reserve surveillance and enforcement of such use restrictions, including appropriate government enforcement agencies;
9. If applicable, a restoration plan describing those portions of the site that may require habitat modification to restore natural conditions;
10. If applicable, a resource manipulation plan, describing those portions of the Reserve buffer in which long-term pre-existing (prior to designation) manipulation for reasons not related to research or restoration is occurring. The plan shall explain in detail the nature of such activities, shall justify why such manipulation should be permitted to continue within the reserve buffer; and shall describe possible effects of this manipulation on key land and water areas and their resources;
11. A proposed memorandum of understanding (MOU) between the state and NOAA regarding the Federal-state relationship during the establishment and development of the National Estuarine Research Reserve, and expressing a long-term commitment by the state to maintain and manage the Reserve in accordance with section 315 of the Act, 16 U.S.C. 1461, and applicable regulations. In conjunction with the MOU, and where possible under state law, the state will consider taking appropriate administrative or legislative action to ensure the long-term protection and operation of the National Estuarine Research Reserve. If other MOUs are necessary (such as with a Federal agency, another state agency or private organization), drafts of such MOUs must be included in the plan. All necessary MOU's shall be signed prior to Reserve designation; and



12. If the state has a federally approved coastal management program, a certification that the National Estuarine Research Reserve is consistent to the maximum extent practicable with that program. See Secs. 921.4(b) and 921.30(b).

(b) Regarding the preparation of an EIS under the National Environmental Policy Act on a National Estuarine Research Reserve proposal, the state and NOAA shall collect all necessary information concerning the socioeconomic and environmental impacts associated with implementing the draft management plan and feasible alternatives to the plan. Based on this information, the state will draft and provide NOAA with a preliminary EIS.

(c) Early in the development of the draft management plan and the draft EIS, the state and NOAA shall hold a scoping meeting (pursuant to NEPA) in the area or areas most affected to solicit public and government comments on the significant issues related to the proposed action. NOAA will publish a notice of the meeting in the Federal Register at least 15 days prior to the meeting. The state shall be responsible for publishing a similar notice in the local media.

(d) NOAA will publish a Federal Register notice of intent to prepare a draft EIS. After the draft EIS is prepared and filed with the Environmental Protection Agency (EPA), a Notice of Availability of the draft EIS will appear in the Federal Register. Not less than 30 days after publication of the notice, NOAA will hold at least one public hearing in the area or areas most affected by the proposed national estuarine research reserve. The hearing will be held no sooner than 15 days after appropriate notice of the meeting has been given in the principal news media by the state and in the Federal Register by NOAA. After a 45-day comment period, a final EIS will be prepared by the state and NOAA.

### **Sec. 921.20 General.**

The acquisition and development period is separated into two major phases. After NOAA approval of the site, draft management plan and draft MOU, and completion of the final EIS, a coastal state is eligible for an initial acquisition and development award(s). In this initial phase, the state should work to meet the criteria required for formal research reserve designation; e.g., establishing adequate state control over the key land and water areas as specified in the draft management plan and preparing the final management plan. These requirements are specified in Sec. 921.30. Minor construction in accordance with the draft management plan may also be conducted during this initial phase. The initial acquisition and development phase is expected to last no longer than three years. If necessary, a longer time period may be negotiated between the state and NOAA. After Reserve designation, a state is eligible for a supplemental acquisition and development award(s) in accordance with Sec. 921.31. In this post-designation acquisition and development phase, funds may be used in accordance with the final management plan to construct research and educational facilities, complete any remaining land acquisition, for program development, and for restorative activities identified in the final management

plan. In any case, the amount of Federal financial assistance provided to a coastal state with respect to the acquisition of lands and waters, or interests therein, for any one National Estuarine Research Reserve may not exceed an amount equal to 50 percent of the costs of the lands, waters, and interests therein or \$5,000,000, whichever amount is less, except when the financial assistance is provided from amounts recovered as a result of damage to natural resources located in the coastal zone, in which case the assistance may be used to pay 100 percent of all actual costs of activities carrier out with this assistance, as long as such funds are available.

*[58 FR 38215, July 15, 1993, as amended at 62 FR 12540, Mar. 17, 1997; 63 FR 26717, May 14, 1998].*

### **Sec. 921.21 Initial acquisition and development awards.**

(a) Assistance is provided to aid the recipient prior to designation in:

1. Acquiring a fee simple or less-than-fee simple real property interest in land and water areas to be included in the Reserve boundaries (see Sec. 921.13(a)(7); Sec. 921.30(d));
2. Minor construction, as provided in paragraphs (b) and (c) of this section;
3. Preparing the final management plan; and
4. Initial management costs, e.g., for implementing the NOAA approved draft management plan, hiring a Reserve manager and other staff as necessary and for other management-related activities. Application procedures are specified in subpart I.

(b) The expenditure of Federal and state funds on major construction activities is not allowed during the initial acquisition and development phase. The preparation of architectural and engineering plans, including specifications, for any proposed construction, or for proposed restorative activities, is permitted. In addition, minor construction activities, consistent with paragraph (c) of this section also are allowed. The NOAA-approved draft management plan must, however, include a construction plan and a public access plan before any award funds can be spent on construction activities.

(c) Only minor construction activities that aid in implementing portions of the management plan (such as boat ramps and nature trails) are permitted during the initial acquisition and development phase. No more than five (5) percent of the initial acquisition and development award may be expended on such activities. NOAA must make a specific determination, based on the final EIS, that the construction activity will not be detrimental to the environment.

(d) Except as specifically provided in paragraphs (a) through (c) of this section, construction projects, to be funded in whole or in part under an acquisition and development award(s), may not be initiated until the Reserve receives formal designation (see Sec. 921.30). This requirement has been adopted to ensure that substantial progress

in establishing adequate state control over key land and water areas has been made and that a final management plan is completed before major sums are spent on construction. Once substantial progress in establishing adequate state control/acquisition has been made, as defined by the state in the management plan, other activities guided by the final management plan may begin with NOAA's approval.

(e) For any real property acquired in whole or part with Federal funds for the Reserve, the state shall execute suitable title documents to include substantially the following provisions, or otherwise append the following provisions in a manner acceptable under applicable state law to the official land record(s):

1. Title to the property conveyed by this deed shall vest in the [recipient of the award granted pursuant to section 315 of the Act, 16 U.S.C. 1461 or other NOAA approved state agency] subject to the condition that the designation of the [name of National Estuarine Reserve] is not withdrawn and the property remains part of the federally designated [name of National Estuarine Research Reserve]; and
2. In the event that the property is no longer included as part of the Reserve, or if the designation of the Reserve of which it is part is withdrawn, then NOAA or its successor agency, after full and reasonable consultation with the State, may exercise the following rights regarding the disposition of the property:
  - (i) The recipient may retain title after paying the Federal Government an amount computed by applying the Federal percentage of participation in the cost of the original project to the current fair market value of the property;
  - (ii) If the recipient does not elect to retain title, the Federal Government may either direct the recipient to sell the property and pay the Federal Government an amount computed by applying the Federal percentage of participation in the cost of the original project to the proceeds from the sale (after deducting actual and reasonable selling and repair or renovation expenses, if any, from the sale proceeds), or direct the recipient to transfer title to the Federal Government. If directed to transfer title to the Federal Government, the recipient shall be entitled to compensation computed by applying the recipient's percentage of participation in the cost of the original project to the current fair market value of the property; and
  - (iii) Fair market value of the property must be determined by an independent appraiser and certified by a responsible official of the state, as provided by Department of Commerce regulations at 15 CFR part 24, and Uniform Relocation Assistance and Real Property Acquisition for Federal and Federally assisted programs at 15 CFR part 11.

(f) Upon instruction by NOAA, provisions analogous to those of Sec. 921.21(e) shall be included in the documentation underlying less-than-fee-simple interests acquired in whole or part with Federal funds.

(g) Federal funds or non-Federal matching share funds shall not be spent to acquire a real property interest in which the state will own the land concurrently with another entity unless the property interest has been identified as a part of an acquisition strategy

pursuant to Sec. 921.13(7) which has been approved by NOAA prior to the effective date of these regulations.

(h) Prior to submitting the final management plan to NOAA for review and approval, the state shall hold a public meeting to receive comment on the plan in the area affected by the estuarine research reserve. NOAA will publish a notice of the meeting in the Federal Register at least 15 days prior to the public meeting. The state shall be responsible for having a similar notice published in the local newspaper(s).

### **Sec. 921.30 Designation of National Estuarine Research Reserves.**

(a) The Under Secretary may designate an area proposed for designation by the Governor of the state in which it is located, as a National Estuarine Research Reserve if the Under Secretary finds:

1. The area is a representative estuarine ecosystem that is suitable for long-term research and contributes to the biogeographical and typological balance of the System;
2. Key land and water areas of the proposed Reserve, as identified in the management plan, are under adequate state control sufficient to provide long-term protection for reserve resources to ensure a stable environment for research;
3. Designation of the area as a Reserve will serve to enhance public awareness and understanding of estuarine areas, and provide suitable opportunities for public education and interpretation;
4. A final management plan has been approved by NOAA;
5. An MOU has been signed between the state and NOAA ensuring a long-term commitment by the state to the effective operation and implementation of the area as a National Estuarine Research Reserve;
6. All MOU's necessary for reserve management (i.e., with relevant Federal, state, and local agencies and/or private organizations) have been signed; and
7. The coastal state in which the area is located has complied with the requirements of subpart B.

(b) NOAA will determine whether the designation of a National Estuarine Research Reserve in a state with a federally approved coastal zone management program directly affects the coastal zone. If the designation is found to directly affect the coastal zone, NOAA will make a consistency determination pursuant to Sec. 307(c)(1) of the Act, 16 U.S.C. 1456, and 15 CFR part 930, subpart C. See Sec. 921.4(b). The results of this consistency determination will be published in the Federal Register when the notice of designation is published. See Sec. 921.30(c).

(c) NOAA will publish the notice of designation of a National Estuarine Research Reserve in the Federal Register. The state shall be responsible for having a similar notice published in the local media.

(d) The term state control in Sec. 921.30(a)(3) does not necessarily require that key land and water areas be owned by the state in fee simple. Acquisition of less-than-fee simple interests e.g., conservation easements) and utilization of existing state regulatory measures are encouraged where the state can demonstrate that these interests and measures assure adequate long-term state control consistent with the purposes of the research reserve (see also Secs. 921.13(a)(7); 921.21(g)). Should the state later elect to purchase an interest in such lands using NOAA funds, adequate justification as to the need for such acquisition must be provided to NOAA.

### **Sec. 921.31 Supplemental acquisition and development awards.**

After National Estuarine Research Reserve designation, and as specified in the approved management plan, a coastal state may request a supplemental acquisition and/or development award(s) for acquiring additional property interests identified in the management plan as necessary to strengthen protection of key land and water areas and to enhance long-term protection of the area for research and education, for facility and exhibit construction, for restorative activities identified in the approved management plan, for administrative purposes related to acquisition and/or facility construction and to develop and/or upgrade research, monitoring and education/interpretive programs. Federal financial assistance provided to a National Estuarine Research Reserve for supplemental development costs directly associated with facility construction (i.e., major construction activities) may not exceed 70 percent of the total project cost, except when the financial assistance is provided from amounts recovered as a result of damage to natural resources located in the coastal zone, in which case the assistance may be used to pay 100 percent of the costs. NOAA must make a specific determination that the construction activity will not be detrimental to the environment. Acquisition awards for the acquisition of lands or waters, or interests therein, for any one reserve may not exceed an amount equal to 50 percent of the costs of the lands, waters, and interests therein of \$5,000,000, whichever amount is less, except when the financial assistance is provided from amounts recovered as result of damage to natural resources located in the coastal zone, in which case the assistance may be used to pay 100 percent of all actual costs of activities carrier out with this assistance, as long as such funds are available. In the case of a biogeographic region (see appendix I) shared by two or more states, each state is eligible independently for Federal financial assistance to establish a separate National Estuarine Research Reserve within their respective portion of the shared biogeographic region. Application procedures are specified in subpart I. Land acquisition must follow the procedures specified in Secs. 921.13(a)(7), 921.21(e) and (f) and 921.81.

*[58 FR 38215, July 15, 1993, as amended at 62 FR 12540, Mar. 17, 1997; 63 FR 26717, May 14, 1998].*

### **Sec. 921.32 Operation and management: Implementation of the management plan.**

(a) After the Reserve is formally designated, a coastal state is eligible to receive Federal funds to assist the state in the operation and management of the Reserve including the management of research, monitoring, education, and interpretive programs. The purpose of this Federally funded operation and management phase is to implement the approved final management plan and to take the necessary steps to ensure the continued effective operation of the Reserve.

(b) State operation and management of the Reserves shall be consistent with the mission, and shall further the goals of the National Estuarine Research Reserve program (see Sec. 921.1).

(c) Federal funds are available for the operation and management of the Reserve. Federal funds provided pursuant to this section may not exceed 70 percent of the total cost of operating and managing the Reserve for any one year, except when the financial assistance is provided from amounts recovered as a result of damage to natural resources located in the coastal zone, in which case the assistance may be used to pay 100 percent of the costs. In the case of a biogeographic region (see Appendix I) shared by two or more states, each state is eligible for Federal financial assistance to establish a separate Reserve within their respective portion of the shared biogeographic region (see Sec. 921.10).

(d) Operation and management funds are subject to the following limitations:

1. Eligible coastal state agencies may apply for up to the maximum share available per Reserve for that fiscal year. Share amounts will be announced annually by letter from the Sanctuary and Reserves Division to all participating states. This letter will be provided as soon as practicable following approval of the Federal budget for that fiscal year.
2. No more than ten percent of the total amount (state and Federal shares) of each operation and management award may be used for construction-type activities.

*[58 FR 38215, July 15, 1993, as amended at 62 FR 12541, Mar. 17, 1997].*

### **Sec. 921.33 Boundary changes, amendments to the management plan, and addition of multiple-site components.**

(a) Changes in the boundary of a Reserve and major changes to the final management plan, including state laws or regulations promulgated specifically for the Reserve, may be made only after written approval by NOAA. NOAA may require public notice, including notice in the Federal Register and an opportunity for public comment before approving a boundary or management plan change. Changes in the boundary of a Reserve involving the acquisition of properties not listed in the management plan or final EIS require public notice and the opportunity for comment; in certain cases, a categorical exclusion, an environmental assessment and possibly an environmental impact statement may be

required. NOAA will place a notice in the Federal Register of any proposed changes in Reserve boundaries or proposed major changes to the final management plan. The state shall be responsible for publishing an equivalent notice in the local media. See also requirements of Secs. 921.4(b) and 921.13(a)(11).

(b) As discussed in Sec. 921.10(b), a state may choose to develop a multiple-site National Estuarine Research Reserve after the initial acquisition and development award for a single site has been made. NOAA will publish notice of the proposed new site including an invitation for comments from the public in the Federal Register. The state shall be responsible for publishing an equivalent notice in the local newspaper(s). An EIS, if required, shall be prepared in accordance with section Sec. 921.13 and shall include an administrative framework for the multiple-site Reserve and a description of the complementary research and educational programs within the Reserve. If NOAA determines, based on the scope of the project and the issues associated with the additional site(s), that an environmental assessment is sufficient to establish a multiple-site Reserve, then the state shall develop a revised management plan which, concerning the additional component, incorporates each of the elements described in Sec. 921.13(a). The revised management plan shall address goals and objectives for all components of the multi-site Reserve and the additional component's relationship to the original site(s).

(c) The state shall revise the management plan for a Reserve at least every five years, or more often if necessary. Management plan revisions are subject to (a) above.

(d) NOAA will approve boundary changes, amendments to management plans, or the addition of multiple-site components, by notice in the Federal Register. If necessary NOAA will revise the designation document (findings) for the site.

#### **Sec. 921.40 Ongoing oversight and evaluations of designated National Estuarine Research Reserves.**

(a) The Sanctuaries and Reserve Division shall conduct, in accordance with section 312 of the Act and procedures set forth in 15 CFR part 928, ongoing oversight and evaluations of Reserves. Interim sanctions may be imposed in accordance with regulations promulgated under 15 CFR part 928.

(b) The Assistant Administrator may consider the following indicators of non-adherence in determining whether to invoke interim sanctions:

1. Inadequate implementation of required staff roles in administration, research, education/interpretation, and surveillance and enforcement. Indicators of inadequate implementation could include: No Reserve Manager, or no staff or insufficient staff to carry out the required functions.
2. Inadequate implementation of the required research plan, including the monitoring design. Indicators of inadequate implementation could include: Not

- carrying out research or monitoring that is required by the plan, or carrying out research or monitoring that is inconsistent with the plan.
3. Inadequate implementation of the required education/interpretation plan. Indicators of inadequate implementation could include: Not carrying out education or interpretation that is required by the plan, or carrying out education/interpretation that is inconsistent with the plan.
  4. Inadequate implementation of public access to the Reserve. Indicators of inadequate implementation of public access could include: Not providing necessary access, giving full consideration to the need to keep some areas off limits to the public in order to protect fragile resources.
  5. Inadequate implementation of facility development plan. Indicators of inadequate implementation could include: Not taking action to propose and budget for necessary facilities, or not undertaking necessary construction in a timely manner when funds are available.
  6. Inadequate implementation of acquisition plan. Indicators of inadequate implementation could include: Not pursuing an aggressive acquisition program with all available funds for that purpose, not requesting promptly additional funds when necessary, and evidence that adequate long-term state control has not been established over some core or buffer areas, thus jeopardizing the ability to protect the Reserve site and resources from offsite impacts.
  7. Inadequate implementation of Reserve protection plan. Indicators of inadequate implementation could include: Evidence of non-compliance with Reserve restrictions, insufficient surveillance and enforcement to assure that restrictions on use of the Reserve are adhered to, or evidence that Reserve resources are being damaged or destroyed as a result of the above.
  8. Failure to carry out the terms of the signed Memorandum of Understanding (MOU) between the state and NOAA, which establishes a long-term state commitment to maintain and manage the Reserve in accordance with section 315 of the Act. Indicators of failure could include: State action to allow incompatible uses of state-controlled lands or waters in the Reserve, failure of the state to bear its fair share of costs associated with long-term operation and management of the Reserve, or failure to initiate timely updates of the MOU when necessary.

#### **Sec. 921.41 Withdrawal of designation.**

The Assistant Administrator may withdraw designation of an estuarine area as a National Estuarine Research Reserve pursuant to and in accordance with the procedures of section 312 and 315 of the Act and regulations promulgated thereunder.



**Old Woman Creek NERR  
Management Plan**

**APPENDIX B**

**Memorandum of Understanding, NOAA & ODW  
detailing federal-state roles in the management of  
the Reserve**

Memorandum of Agreement  
Among the  
National Oceanic and Atmospheric Administration  
the Ohio Department of Natural Resources, Division of Wildlife  
and the Erie Soil and Water Conservation District  
Detailing the state-federal roles in the  
Management of the Old Woman Creek National Estuarine Research Reserve

## INTRODUCTION

1. This Memorandum states the provisions for the cooperative management of the Old Woman Creek National Estuarine Research Reserve (NERR) in the State of Ohio, among the Ohio Department of Natural Resources, Division of Wildlife (Division), the Erie Soil and Water Conservation District (District), and the National Oceanic and Atmospheric Administration's Office of Ocean and Coastal Resource Management (NOAA).
2. This Memorandum supersedes the previous Memorandum of Agreement executed on July 7, 1999 between NOAA and the Ohio Department of Natural Resources regarding the management of the Old Woman Creek NERR.
3. The State of Ohio has determined that the waters and related coastal habitats of Old Woman Creek NERR provide unique opportunities for study of natural and human processes occurring within the estuarine ecosystems of the State to contribute to the science of estuarine ecosystem processes, enhance environmental education opportunities, and provide scientific information for effective coastal zone management in the State of Ohio.
4. The State of Ohio has determined that the resources of the Old Woman Creek NERR and the values they represent to the citizens of Ohio and the United States will benefit from the management of these resources as part of the National Estuarine Research Reserve System.
5. NOAA has concurred with that finding and pursuant to its authority under section 315 of the Coastal Zone Management Act of 1972, as amended (CZMA, 16 U.S.C. 1461) and in accordance with implementing regulations at 15 Code of Federal Regulations 921.30 has designated the Old Woman Creek NERR.
6. The Ohio Department of Natural Resources, Division of Wildlife, as the agency designated by the Governor of Ohio, is responsible for managing the Old Woman Creek NERR and acknowledges the value of state-federal cooperation for the long-term management of the reserve in a manner consistent with the purpose of their designation.
7. The Old Woman Creek NERR management plan describes the goals, objectives, strategies/actions, administrative structure, and institutional arrangements for the reserve.

8. As a core administrative partner of the Reserve, the Erie Soil and Water Conservation District has a program focus on watershed management within the Old Woman Creek ecosystem and a mission to provide technical assistance to landowners relating to effective soil and water conservation practices.
9. As a state partner and manager of the Old Woman Creek NERR, the Division is responsible for deciding how to disburse section 315 CZMA federal funds that support the NERR.
10. The District is the state subdivision agency that will assist the Division by receiving 315 CZMA funds supporting Old Woman Creek research and monitoring projects within the Old Woman Creek watershed, pursuant to its authority under Chapter 1515 of the Ohio Revised Code.
11. The District's assistance to the Division as described in paragraph 8 does not modify the Division's authority or responsibility for all Old Woman Creek NERR operations, such as supervising staff, operating programs, managing activities, protecting resources, and complying with all requirements of 15 CFR Part 921.

#### ARTICLE I: STATE-FEDERAL ROLES IN RESERVE MANAGEMENT

##### A. The Division shall:

1. operate the Old Woman Creek NERR and be responsible to provide supervision of staff, programs, and all management activities, including complying with regulatory requirements of 15 CFR Part 921 and associated state match obligations;
2. ensure that the Old Woman Creek NERR is operated in compliance with all federal and state laws and regulations, the reserve management plan, and is operated consistent with all terms and conditions of NOAA financial assistance awards of Section 315 CZMA, and that the Old Woman Creek NERR management plan is consistent with the provisions of the CZMA and implementing regulations;
3. ensure conservation of the natural and cultural resources of the Old Woman Creek NERR, and ensure enforcement of the provisions of state law, including rules and regulations of the Ohio Coastal Management Program;
4. ensure adequate, long-term protection and management of lands included within the reserve boundary;
5. annually apply for, budget, and allocate funds received for reserve operations, research and monitoring, education and stewardship; and as necessary, land acquisition and reserve facility construction;

6. conduct and coordinate research and monitoring programs that encourage scientists from a variety of institutions to work together to understand the ecology of the reserve ecosystem to improve coastal and wetland resource management;
  7. conduct and maintain programs that disseminate research results via materials, activities, workshops, and conferences to resource users, state and local agencies, school systems, the general public, and other interested parties;
  8. provide staff, and endeavor to secure state funding for the manager, education coordinator and research coordinator;
  9. secure facilities and equipment required to implement relevant provisions of the reserve management plan;
  10. ensure adequate funding for facilities operation and maintenance;
  11. maintain effective liaison with local, regional, state, and federal policy makers, regulators and the general public;
  12. serve as principal contact for issues involving proposed boundary changes and/or amendments to the reserve management plan;
  13. comply with all terms and conditions of NOAA financial assistance awards pertaining to Section 315 of the CZMA for operations of the Old Woman Creek NERR;
  14. generate and provide financial assistance award progress reports to meet NOAA award obligations;
  15. respond to NOAA's requests for information other than progress reports and financial status reports;
  16. pre-approve an annual budget and work plan to be submitted to NOAA by the District for support of Old Woman Creek NERR operations and provide a letter pre-approving the budget prior to application for 315 CZMA funds. The basis for approval will be a determination of consistency with a scope of work agreement between the Division and District.
- B. The District's responsibilities with respect to the Old Woman Creek NERR shall be limited to the following:
1. annually submit applications, and accept federal financial assistance awards to support operations of the Old Woman Creek NERR under section 315 of the CZMA;
  2. disburse Section 315 CZMA federal funds received for support of Old Woman Creek NERR in accordance with a budget and work plan approved by the Division;

3. provide technical assistance and staff support for habitat stewardship projects within Reserve boundaries;
4. coordinate and conduct Old Woman Creek watershed-scale research, monitoring, and stewardship projects;
5. assist Old Woman Creek NERR with the transfer of research results and information that supports sound coastal and wetland stewardship decision-making;
6. comply with all terms and conditions of NOAA financial assistance awards pertaining to Section 315 of the CZMA for operations of the Old Woman Creek NERR;
7. submit required financial reports to NOAA for each federal financial assistance operations awards under Section 315 of the CZMA;
8. submit required performance progress reports to NOAA for each federal financial assistance operations award generated in collaboration with the Old Woman Creek NERR under Section 315 of the CZMA.
9. Provide matching funds for CZMA Section 315 federal assistance awards needed to complete tasks undertaken pursuant to this paragraph if the federal funds are not matched by the Division.

C. NOAA's Office of Ocean and Coastal Resource Management shall:

1. administer the provisions of Sections 315 and 312 of the CZMA to ensure that the reserve operates in accordance with the goals of the reserve system and the Old Woman Creek NERR management plan;
2. review and process applications for federal financial assistance awards from the Division and District consistent with 15 CFR Part 921 to support Old Woman Creek NERR and, as appropriate, process applications from the Division for land acquisition and facility construction;
3. advise the Division and District of existing and emerging national and regional issues that have bearing on the reserve and reserve system;
4. maintain an information exchange network among reserves, including available research and monitoring data and educational materials developed within the reserve system;
5. to the extent possible, facilitate NOAA resources and capabilities in support of reserve goals and programs.

#### D. General Provisions

1. Nothing in this agreement or subsequent financial assistance awards shall obligate any party in the expenditure of funds, or for future payments of money, in excess of appropriations authorized by law.
2. Upon termination of this agreement or any subsequent financial assistance awards to the Division or District for the Old Woman Creek NERR, any equipment purchased for studies to further this agreement will be disposed of in accordance with 15 CFR 24.32.
3. A free exchange of research and assessment data between the parties is encouraged and is necessary to ensure success of cooperative studies.

#### E. Other Provisions

1. Nothing in this agreement diminishes the independent authority or coordination responsibility of either party in administering its respective statutory obligations. Nothing in this agreement is intended to conflict with current written directives or policies of either party. If the terms of this agreement are inconsistent with existing written directives or policies of either party entering this agreement, then those portions of the agreement which are determined to be inconsistent with such written directives and policies shall be invalid; but the remaining terms not affected by the inconsistency shall remain in full force and effect. At the first opportunity for revision of this agreement, all necessary changes shall be made by either an amendment to this agreement or by entering in a new superseding agreement, which ever is deemed expedient to the interested parties. Should disagreement arise on the interpretation of the provisions and/or amendments of this agreement that cannot be resolved by negotiations at the operating level of each party, the area(s) of disagreement shall be stated in writing by each party and promptly presented to a mutually approved mediator for non-binding mediation. If the parties cannot agree on the choice of a mediator or if the mediation does not resolve the dispute to the mutual approval of the parties, the parties are free to pursue any other legal remedies that are available.

#### ARTICLE II: REAL PROPERTY ACQUIRED FOR PURPOSE OF THE RESERVE

In addition to acknowledging the rest of the requirements set forth at 15 CFR Part 921, the Division specifically acknowledges and agrees to fully comply with conditions set forth at 15 CFR 921.21 (e), which specify the legal documentation requirements concerning the use and disposition of real property acquired for reserve purposes with federal funds under Section 315 of the CZMA.

#### ARTICLE III: PROGRAM EVALUATION

The Office of Ocean and Coastal Resource Management Division of NOAA will schedule periodic evaluations of the Division and the District's performance in meeting the terms of this agreement, financial assistance awards, and the reserve management plan. Where findings of

deficiency occur, NOAA may initiate action in accordance with the designation withdrawal or interim sanctions procedures established by the CZMA and applicable regulations at 15 CFR 921.40-41.

#### ARTICLE IV: EFFECTIVE DATE, REVIEW, AMENDMENT AND TERMINATION

- A. This agreement is effective on the date of the last signature on this agreement and shall be in effect until terminated by any of the parties.
- B. This agreement will be reviewed periodically by all parties and may only be amended by the mutual written consent of each party.
- C. This agreement may be terminated by mutual consent of either party, or by NOAA if NOAA withdraws designation of the reserve within the reserve system, pursuant to applicable provisions of the CZMA and its implementing regulations as described under 15 CFR 923 Subpart L, or if NOAA finds that the Division or the District fails to comply with this MOA. The agreement may be terminated by the Division with or without cause. The District may terminate its participation and obligations under this agreement with or without cause. Should this agreement be terminated, reimbursement of unexpended funds from financial assistance awards shall be determined on a pro rata basis according to the amount of work done by the parties at the time of termination. Additionally, reimbursement for land purchased and facilities constructed with NOAA funds shall be consistent with terms and special award conditions of financial assistance awards.
- D. If any clause, sentence or other portion of this MOA shall become illegal, null or void for any reason, the remaining portions of this MOA shall remain in full force and effect.
- E. No waiver of right by any party of any provision of this MOA shall be binding unless expressly confirmed in writing by the party giving the waiver.

IN WITNESS THEREOF, the parties have caused this agreement to be executed.

Donna Wieting

Donna Wieting  
Acting Director  
Office of Ocean and Coastal Resource  
Management  
National Ocean Service  
National Oceanic and  
Atmospheric Administration  
U.S. Department of Commerce

Richard B. Miller AS. (FRI)

Sean D. Logan, Director  
Ohio Department of Natural  
Resources

8/5/10  
Date

3/2/10  
Date

Kurt Heyman

Kurt Heyman, Chair  
Erie Soil and Water Conservation District

David M. Graham

David M. Graham, Chief  
Ohio Division of Wildlife

2/19/2010  
Date

2-25-10  
Date



**Old Woman Creek NERR  
Management Plan**

**APPENDIX C**

**Ohio Revised Code Chapter 1517  
Relating to nature preserves**

## **APPENDIX C. OHIO REVISED CODE (ORC) CHAPTER 1517: DIVISION OF NATURAL AREAS AND PRESERVES**

### **1517.01 Division of natural areas and preserves definitions**

As used in Chapter 1517. of the Revised Code:

(A) "Natural area" means an area of land or water which either retains to some degree or has re-established its natural character, although it need not be completely undisturbed, or has unusual flora, fauna, geological, archeological, scenic, or similar features of scientific or educational interest.

(B) "Nature preserve" means an area which is formally dedicated under section 1517.05 of the Revised Code.

Effective Date: 08-31-1970

### **1517.02 Chief of division - powers and duties**

There is hereby created in the department of natural resources the division of natural areas and preserves, which shall be administered by the chief of natural areas and preserves. The chief shall take an oath of office and shall file in the office of the secretary of state a bond signed by the chief and by a surety approved by the governor for a sum fixed pursuant to section 121.11 of the Revised Code.

The chief shall administer a system of nature preserves and wild, scenic, and recreational river areas. The chief shall establish a system of nature preserves through acquisition and dedication of natural areas of state or national significance, which shall include, but not be limited to, areas that represent characteristic examples of Ohio's natural landscape types and its natural vegetation and geological history. The chief shall encourage landowners to dedicate areas of unusual significance as nature preserves, and shall establish and maintain a registry of natural areas of unusual significance.

The chief may supervise, operate, protect, and maintain wild, scenic, and recreational river areas, as designated by the director of natural resources. The chief may cooperate with federal agencies administering any federal program concerning wild, scenic, or recreational river areas.

The chief shall do the following:

(A) Formulate policies and plans for the acquisition, use, management, and protection of nature preserves;

(B) Formulate policies for the selection of areas suitable for registration;

(C) Formulate policies for the dedication of areas as nature preserves;

(D) Prepare and maintain surveys and inventories of natural areas, rare and endangered species of plants and animals, and other unique natural features. The information shall be stored in the Ohio natural heritage database, established pursuant to this division, and may be made available to any individual or private or public agency for research, educational, environmental, land management, or other similar purposes that are not detrimental to the conservation of a species or feature. Information regarding sensitive site locations of species that are listed pursuant to

section 1518.01 of the Revised Code and of unique natural features that are included in the Ohio natural heritage database is not subject to section 149.43 of the Revised Code if the chief determines that the release of the information could be detrimental to the conservation of a species or unique natural feature.

(E) Adopt rules for the use, visitation, and protection of nature preserves, natural areas owned or managed through easement, license, or lease by the department and administered by the division, and lands owned or managed through easement, license, or lease by the department and administered by the division that are within or adjacent to any wild, scenic, or recreational river area, in accordance with Chapter 119. of the Revised Code;

(F) Provide facilities and improvements within the state system of nature preserves that are necessary for their visitation, use, restoration, and protection and do not impair their natural character;

(G) Provide interpretive programs and publish and disseminate information pertaining to nature preserves and natural areas for their visitation and use;

(H) Conduct and grant permits to qualified persons for the conduct of scientific research and investigations within nature preserves;

(I) Establish an appropriate system for marking nature preserves;

(J) Publish and submit to the governor and the general assembly a biennial report of the status and condition of each nature preserve, activities conducted within each preserve, and plans and recommendations for natural area preservation.

Effective Date: 05-03-1990; 12-30-2004; 06-27-2005; 09-29-2005; 04-06-2007

### **1517.021 Prohibition**

No person shall violate any rule adopted pursuant to division (E) of section 1517.02 of the Revised Code.

Effective Date: 03-23-1973

### **1517.03, 1517.04 Repealed**

Effective Date: 12-30-2004

### **1517.05 Nature preserves - uses and purposes**

The department of natural resources, for and on behalf of the state, shall acquire a system of nature preserves for the following uses and purposes:

(A) For scientific research in such fields as ecology, taxonomy, genetics, forestry, pharmacology, agriculture, soil science, geology, paleontology, conservation, and similar fields;

(B) For the teaching of biology, natural history, ecology, geology, conservation, and other subjects;

- (C) As habitats for plant and animal species and communities and other natural objects;
- (D) As reservoirs of natural materials;
- (E) As places of natural interest and beauty;
- (F) For visitation whereby persons may observe and experience natural biotic and environmental systems of the earth and their processes;
- (G) To promote understanding and appreciation of the aesthetic, cultural, scientific, and spiritual values of such areas by the people of the state;
- (H) For the preservation and protection of nature preserves against modification or encroachment resulting from occupation, development, or other use that would destroy their natural or aesthetic conditions.

The director of natural resources shall accept natural areas by articles of dedication or gift, provided that funds and services are available for their preservation and protection.

A nature preserve is established when articles of dedication have been filed by or at the direction of the owner of land, or a governmental agency having ownership or control thereof, in the office of the county recorder of the county in which the land is located.

Articles of dedication shall be executed by the owner of the land in the same manner and with the same effect as a conveyance of an interest in land and shall be irrevocable except as provided in this section. The county recorder may not accept articles of dedication for recording unless they have been accepted by the director of natural resources. The director may not accept articles of dedication unless they contain terms restricting the use of the land that adequately provide for its preservation and protection against modification or encroachment resulting from occupation, development, or other use that would destroy its natural or aesthetic conditions for one or more of the uses and purposes set forth in this section. Wherever possible and consistent with such preservation and protection of the land, the articles shall provide for public access in order that the maximum benefit be obtained for the uses and purposes stated in this section.

Articles of dedication may contain provisions for the management, custody, and transfer of land, provisions defining the rights of the owner or operating agency, and the department, and other provisions necessary or advisable to carry out the uses and purposes for which the land is dedicated. They may contain conditions under which the owner and the director of natural resources may agree to rescind the articles.

The attorney general, upon request of the director of natural resources, may bring an action for injunction in any court of competent jurisdiction to enforce the terms of articles of dedication.

The department may make or accept amendments of any articles of dedication upon terms and conditions that will not destroy the natural or aesthetic conditions of a preserve. If the fee simple interest in the area or preserve is not held by the state, no amendments shall be made without the written consent of the owner. Each amendment shall be recorded in the same manner as the articles of dedication.

Effective Date: 06-06-2003; 12-30-2004

### **1517.051 Prohibited acts**

No person shall violate any terms or conditions of the articles of dedication of a nature preserve accepted by the director and filed with the county recorder. The director may order any person to cease and desist from any such violation. No person shall violate any such order.

Effective Date: 03-23-1973

### **1517.06 Nature preserves to be held in trust**

Nature preserves dedicated under section 1517.05 of the Revised Code are to be held in trust, for the uses and purposes set forth in that section, for the benefit of the people of the state of present and future generations. They shall be managed and protected in the manner approved by and subject to rules established by the chief of the division of natural areas and preserves. They shall not be taken for any other use except another public use after a finding by the department of natural resources of the existence of an imperative and unavoidable public necessity for such other public use and with the approval of the governor. Except as may otherwise be provided in the articles of dedication, the department may grant, upon such terms and conditions as it may determine, an estate, interest, or right in, or dispose of, a nature preserve, but only after a finding by the department of the existence of an imperative and unavoidable public necessity for the grant or disposition and with the approval of the governor.

Effective Date: 06-06-2003

### **1517.07 Notice of proposed action - public hearing**

Before the department of natural resources makes any finding of the existence of an imperative and unavoidable public necessity, or grants any estate, interest, or right in a nature preserve or disposes of a nature preserve or of any estate, interest, or right therein as provided in section 1517.06 of the Revised Code, it shall give notice of the proposed action and an opportunity for any person to be heard at a public hearing in the county in which the preserve is located. In the event the preserve is located in more than one county, the public hearing shall be held in the most populous county. The notice shall be published at least once in a newspaper with a general circulation in the county in which the nature preserve is located. The notice shall set forth the substance of the proposed action and describe, with or without legal description, the nature preserve affected, and shall specify a place and time not less than thirty days after the publication for a public hearing before the department on the proposed action. All persons desiring to be heard shall have a reasonable opportunity to be heard prior to action by the department on the proposal.

Effective Date: 06-06-2003

### **1517.08 Dedication of natural areas**

All departments, agencies, units, instrumentalities, and political subdivisions of the state, including, counties, townships, municipal corporations, park districts, conservancy districts, universities, colleges, and school districts, may dedicate natural areas under their jurisdiction in accordance with section 1517.05 of the Revised Code.

Effective Date: 08-31-1970

## **1517.09 Construction of chapter**

Nothing contained in this chapter shall be construed as interfering with the purposes stated in the establishment of or pertaining to any state or local park, forest, preserve, wildlife refuge or other area or the proper management and development thereof, except that any agency administering an area dedicated as a nature preserve under section 1517.05 of the Revised Code shall be responsible for preserving the character of the area in accordance with the articles of dedication and the applicable rules with respect thereto established by the chief of the division of natural areas and preserves. Neither the dedication of an area as a nature preserve nor any action taken by the department under any of the provisions of this chapter shall void or replace any protective status under law which the area would have were it not a nature preserve and the protective provisions of this chapter shall be supplemental thereto.

Effective Date: 09-01-1976

## **1517.10 Preserve officers**

(A) As used in this section, "felony" has the same meaning as in section 109.511 of the Revised Code.

(B)(1) Any person selected by the chief of the division of natural areas and preserves for custodial or patrol service on the lands and waters operated or administered by the division shall be employed in conformity with the law applicable to the classified civil service of the state. Subject to division (C) of this section, the chief may designate that person as a preserve officer. A preserve officer, in any nature preserve, in any natural area owned or managed through easement, license, or lease by the department of natural resources and administered by the division, and on lands owned or managed through easement, license, or lease by the department and administered by the division that are within or adjacent to any wild, scenic, or recreational river area established under this chapter and along any trail established under Chapter 1519. of the Revised Code, has the authority specified under section 2935.03 of the Revised Code for peace officers of the department of natural resources to keep the peace, to enforce all laws and rules governing those lands and waters, and to make arrests for violation of those laws and rules, provided that the authority shall be exercised on lands or waters administered by another division of the department only pursuant to an agreement with the chief of that division or to a request for assistance by an enforcement officer of that division in an emergency. A preserve officer, in or along any watercourse within, abutting, or upstream from the boundary of any area administered by the department, has the authority to enforce section 3767.32 of the Revised Code and any other laws prohibiting the dumping of refuse into or along waters and to make arrests for violation of those laws. The jurisdiction of a preserve officer shall be concurrent with that of the peace officers of the county, township, or municipal corporation in which the violation occurs.

The governor, upon the recommendation of the chief, shall issue to each preserve officer a commission indicating authority to make arrests as provided in this section.

The chief shall furnish a suitable badge to each commissioned preserve officer as evidence of the preserve officer's authority.

(2) If any person employed under this section is designated by the chief to act as an agent of the state in the collection of money resulting from the sale of licenses, fees of any nature, or other money belonging to the state, the chief shall require a surety bond from the person in an amount not less than one thousand dollars.

(3) A preserve officer may render assistance to a state or local law enforcement officer at the request of the officer or in the event of an emergency. Preserve officers serving outside the division of natural areas and preserves under this section or serving under the terms of a mutual aid compact authorized under section 1501.02 of the Revised Code shall be considered as performing services within their regular employment for the purposes of compensation, pension or indemnity fund rights, workers' compensation, and other rights or benefits to which they may be entitled as incidents of their regular employment.

Preserve officers serving outside the division of natural areas and preserves under this section or under the terms of a mutual aid compact retain personal immunity from civil liability as specified in section 9.86 of the Revised Code and shall not be considered an employee of a political subdivision for purposes of Chapter 2744. of the Revised Code. A political subdivision that uses preserve officers under this section or under the terms of a mutual aid compact authorized under section 1501.02 of the Revised Code is not subject to civil liability under Chapter 2744. of the Revised Code as a result of any action or omission of any preserve officer acting under this section or under a mutual aid compact.

(C)(1) The chief of the division of natural areas and preserves shall not designate a person as a preserve officer pursuant to division (B)(1) of this section on a permanent basis, on a temporary basis, for a probationary term, or on other than a permanent basis if the person previously has been convicted of or has pleaded guilty to a felony.

(2)(a) The chief of the division of natural areas and preserves shall terminate the employment as a preserve officer of a person designated as a preserve officer under division (B)(1) of this section if that person does either of the following:

(i) Pleads guilty to a felony;

(ii) Pleads guilty to a misdemeanor pursuant to a negotiated plea agreement as provided in division (D) of section 2929.43 of the Revised Code in which the preserve officer agrees to surrender the certificate awarded to the preserve officer under section 109.77 of the Revised Code.

(b) The chief shall suspend from employment as a preserve officer a person designated as a preserve officer under division (B)(1) of this section if that person is convicted, after trial, of a felony. If the preserve officer files an appeal from that conviction and the conviction is upheld by the highest court to which the appeal is taken or if the preserve officer does not file a timely appeal, the chief shall terminate the employment of that preserve officer. If the preserve officer files an appeal that results in the preserve officer's acquittal of the felony or conviction of a misdemeanor, or in the dismissal of the felony charge against the preserve officer, the chief shall reinstate that preserve officer. A preserve officer who is reinstated under division (C)(2)(b) of this section shall not receive any back pay unless that preserve officer's conviction of the felony was reversed on appeal, or the felony charge was dismissed, because the court found insufficient evidence to convict the preserve officer of the felony.

(3) Division (C) of this section does not apply regarding an offense that was committed prior to January 1, 1997.

(4) The suspension from employment, or the termination of the employment, of a preserve officer under division (C)(2) of this section shall be in accordance with Chapter 119. of the Revised Code.

Effective Date: 01-01-2004; 04-06-2007

### **1517.11 Natural areas and preserves fund - use of funds**

There is hereby created in the state treasury the natural areas and preserves fund, which shall consist of moneys transferred into it under section 5747.113 of the Revised Code and of contributions made directly to it. Any person may contribute directly to the fund in addition to or independently of the income tax refund contribution system established in that section.

Moneys in the fund shall be disbursed pursuant to vouchers approved by the director of natural resources for use by the division of natural areas and preserves solely for the following purposes:

- (A) The acquisition of new or expanded natural areas, nature preserves, and wild, scenic, and recreational river areas;
- (B) Facility development in natural areas, nature preserves, and wild, scenic, and recreational river areas;
- (C) Special projects, including, but not limited to, biological inventories, research grants, and the production of interpretive material related to natural areas, nature preserves, and wild, scenic, and recreational river areas;
- (D) Routine maintenance for health and safety purposes.

Moneys appropriated from the fund shall not be used to fund salaries of permanent employees or administrative costs.

All investment earnings of the fund shall be credited to the fund.

Effective Date: 06-30-1997; 04-06-2007

### **1517.12 Lake Katharine management trust fund**

There is hereby created the lake Katharine management trust fund, which shall be administered by the division of natural areas and preserves in the department of natural resources for preservation, management, land acquisition, and educational programs at the lake Katharine nature preserve. The moneys in the fund shall be derived from gifts, donations, bequests, and other moneys for the purposes for which the fund is created. The treasurer of state shall be the custodian of the fund, which shall not be a part of the state treasury. The principal in the fund shall not be expended. Only earnings from investments shall be expended for the purposes for which the fund is created. All disbursements from the fund shall be paid by the treasurer of state upon requisitions signed by the director of natural resources or his designee.

Effective Date: 02-11-1988



### **1517.13 Lake Katharine management fund**

There is hereby created in the state treasury the lake Katharine management fund. All investment earnings of the lake Katharine management trust fund created in section 1517.12 of the Revised Code shall be credited to the fund created in this section and disbursed pursuant to vouchers approved by the director of natural resources for use by the division of natural areas and preserves in the department of natural resources solely for preservation, management, land acquisition, and educational programs at the lake Katharine nature preserve.

Effective Date: 02-11-1988

### **1517.14 Creating wild, scenic, or recreational river areas**

As used in sections 1517.14 to 1517.18 of the Revised Code, "watercourse" means a substantially natural channel with recognized banks and bottom, in which a flow of water occurs, with an average of at least ten feet mean surface water width and at least five miles of length. The director of natural resources or the director's representative may create, supervise, operate, protect, and maintain wild, scenic, and recreational river areas under the classifications established in section 1517.15 of the Revised Code. The director or the director's representative may prepare and maintain a plan for the establishment, development, use, and administration of those areas as a part of the comprehensive state plans for water management and outdoor recreation. The director or the director's representative may cooperate with federal agencies administering any federal program concerning wild, scenic, or recreational river areas.

The director may propose for establishment as a wild, scenic, or recreational river area a part or parts of any watercourse in this state, with adjacent lands, that in the director's judgment possesses water conservation, scenic, fish, wildlife, historic, or outdoor recreation values that should be preserved, using the classifications established in section 1517.15 of the Revised Code. The area shall include lands adjacent to the watercourse in sufficient width to preserve, protect, and develop the natural character of the watercourse, but shall not include any lands more than one thousand feet from the normal waterlines of the watercourse unless an additional width is necessary to preserve water conservation, scenic, fish, wildlife, historic, or outdoor recreation values.

The director shall publish the intention to declare an area a wild, scenic, or recreational river area at least once in a newspaper of general circulation in each county, any part of which is within the area, and shall send written notice of the intention to the legislative authority of each county, township, and municipal corporation and to each conservancy district established under Chapter 6101. of the Revised Code, any part of which is within the area, and to the director of transportation, the director of development, the director of administrative services, and the director of environmental protection. The notices shall include a copy of a map and description of the area.

After thirty days from the last date of publication or dispatch of written notice as required in this section, the director shall enter a declaration in the director's journal that the area is a wild, scenic, or recreational river area. When so entered, the area is a wild, scenic, or recreational river area. The director, after thirty days' notice as prescribed in this section and upon the approval of the recreation and resources commission created in section 1501.04 of the Revised Code, may terminate the status of an area as a wild, scenic, or recreational river area by an entry in the director's journal.

Declaration by the director that an area is a wild, scenic, or recreational river area does not authorize the director or any governmental agency or political subdivision to restrict the use of

land by the owner thereof or any person acting under the landowner's authority or to enter upon the land and does not expand or abridge the regulatory authority of any governmental agency or political subdivision over the area.

The chief of the division of natural areas and preserves or the chief's representative may participate in watershed-wide planning with federal, state, and local agencies in order to protect the values of wild, scenic, and recreational river areas.

Effective Date: 03-18-1999

### **1517.15 River area classifications**

As used in this section, "impoundment" means the reservoir created by a dam or other artificial barrier across a watercourse that causes water to be stored deeper than and generally beyond the banks of the natural channel of the watercourse during periods of normal flow, but does not include water stored behind rock piles, rock riffle dams, and low channel dams where the depth of water is less than ten feet above the channel bottom and is essentially confined within the banks of the natural channel during periods of normal stream flow.

In creating wild, scenic, or recreational river areas, the director of natural resources shall use the following classifications:

(A) "Wild river areas" to include those rivers or sections of rivers that are free of impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially primitive and waters unpolluted, representing vestiges of primitive America;

(B) "Scenic river areas" to include those rivers or sections of rivers that are free of impoundments, with shorelines or watersheds still largely primitive and shorelines largely undeveloped, but accessible in places by roads;

(C) "Recreational river areas" to include those rivers or sections of rivers that are readily accessible by road or railroad, that may have some development along their shorelines, and that may have undergone some impoundment or diversion in the past.

Effective Date: 10-20-1994

### **1517.16 Approving structures and channel modifications**

No state department, state agency, or political subdivision shall build or enlarge any highway, road, or structure or modify or cause the modification of the channel of any watercourse within a wild, scenic, or recreational river area outside the limits of a municipal corporation without first having obtained approval of the plans for the highway, road, or structure or channel modification from the director of natural resources or his representative. The court of common pleas having jurisdiction, upon petition by the director, shall enjoin work on any highway, road, or structure or channel modification for which such approval has not been obtained.

Effective Date: 10-20-1994

### **1517.17 Administering program and areas**

The chief of the division of natural areas and preserves may administer federal financial assistance programs for wild, scenic, and recreational river areas.

The director of natural resources may make a lease or agreement with a political subdivision to administer all or part of a wild, scenic, or recreational river area.

The director may acquire real property or any estate, right, or interest therein for protection and public recreational use as a wild, scenic, or recreational river area.

The chief may expend funds for the acquisition, protection, construction, maintenance, and administration of real property and public use facilities in wild, scenic, or recreational river areas when the funds are so appropriated by the general assembly. The chief may condition such expenditures, acquisition of land or easements, or construction of facilities within a wild, scenic, or recreational river area upon adoption and enforcement of adequate floodplain zoning rules.

Any instrument by which real property is acquired pursuant to this section shall identify the agency of the state that has the use and benefit of the real property as specified in section 5301.012 of the Revised Code.

Effective Date: 10-26-1999

### **1517.18 Advisory council appointed for each area**

The director of natural resources shall appoint an advisory council for each wild, scenic, or recreational river area, composed of not more than ten persons who are representative of local government and local organizations and interests in the vicinity of the wild, scenic, or recreational river area, who shall serve without compensation. The chief of the division of natural areas and preserves or his representative shall serve as an ex officio member of each council.

The terms of all members serving on any advisory council under this section on the effective date of this amendment shall end on January 31, 1995. The director shall appoint new members to serve on each council for terms beginning on February 1, 1995, provided that a member serving on a council on the effective date of this amendment may be appointed to such a new term. The initial members appointed to each council shall serve for terms of not more than three years, with the terms of not more than four members of any council ending in the same year. Thereafter, terms of office shall be for three years commencing on the first day of February and ending on the last day of January.

Each council shall advise the chief on the acquisition of land and easements and on the lands and waters that should be included in a wild, scenic, or recreational river area or a proposed wild, scenic, or recreational river area, facilities therein, and other aspects of establishment and administration of the area that may affect the local interest.

Effective Date: 10-20-1994

### **1517.21 Cave definitions**

As used in sections 1517.21 to 1517.26 of the Revised Code:

(A) "Cave" means a naturally occurring void, cavity, recess, or system of interconnecting passages beneath the surface of the earth or within a cliff or ledge, including, without limitation, a grotto, rock shelter, sinkhole, cavern, pit, natural well, pothole, or subsurface water and drainage system.

(B) "Cave life" means any organism that naturally occurs in, uses, visits, or inhabits any cave, except those animals that are permitted to be taken under Chapter 1533. of the Revised Code.

(C) "Material" includes:

- (1) Any speleothem, whether attached or broken, found in a cave;
- (2) Any clay or mud formation or concretion or sedimentary deposit found in a cave;
- (3) Any scallop, rill, or other corrosional or corrosional feature of a cave;
- (4) Any wall or ceiling of a cave or any other part of the speleogen.

(D) "Owner" means any person having title to land in which a cave is located.

(E) "Speleothem" means any stalactite, stalagmite, or other natural mineral formation or deposit occurring in a cave.

(F) "Speleogen" means the surrounding material or bedrock in which a cave is formed, including walls, floors, ceilings, and similar related structural and geological components.

(G) "Sinkhole" means a closed topographic depression or basin generally draining underground, including, without limitation, a blind valley, swallowhole, or sink.

(H) "Hazard" means a risk of serious physical harm to persons or property.

Effective Date: 03-22-1989

### **1517.22 Protection of cave resources**

The general assembly hereby finds that caves are uncommon geologic phenomena and that the minerals deposited in them may be rare and occur in unique forms of great beauty that are irreplaceable if destroyed. Also irreplaceable are the archeological resources in caves, which are of great scientific and historic value. It is further found that species of cave life are unusual and of limited numbers; that many are rare, threatened, or endangered species; and that caves are a natural conduit for groundwater flow and are highly subject to water pollution, thus having far-reaching effects transcending man's property boundaries. It is therefore declared to be the policy of the general assembly to protect these unique and great natural, historical, scientific, and cultural resources.

Effective Date: 03-22-1989

### **1517.23 Chief of division - duties**

The chief of the division of natural areas and preserves shall do both of the following:

(A) Formulate policies and plans and establish a program incorporating them for the identification and protection of the state's cave resources and adopt, amend, or rescind rules in accordance with Chapter 119. of the Revised Code to implement that program;

(B) Provide technical assistance and management advice to owners upon request concerning the protection of caves on their land.

Effective Date: 03-22-1989; 12-30-2004; 06-27-2005

### **1517.24 Prohibited acts**

(A) Without the express written permission of the owner and, if the owner has leased the land, without the express written permission of the lessee, no person shall knowingly:

(1) Break, break off, crack, carve on, write on, mark on, burn, remove, or in any other manner destroy, deface, mark, or disturb the surfaces of any cave or any natural material found in any cave, whether attached or broken, including, without limitation, speleothems, speleogens, and sedimentary deposits;

(2) Break, force, tamper with, or otherwise disturb any lock, door, gate, or other device designed to limit control, or prevent access to or entry into a cave;

(3) Remove, deface, or tamper with any posted sign giving notice against unauthorized access to or presence in a cave or citing any of the provisions of sections 1517.21 to 1517.26 or division (B) of section 1517.99 of the Revised Code;

(4) Place refuse, garbage, dead animals, sewage, or toxic substances harmful to cave life or humans in a cave;

(5) Burn within a cave any substance other than acetylene gas burned in a carbide lamp that produces smoke or gas that is harmful to cave life;

(6) Use any door, gate, or other device designed to limit, control, or prevent access to or entry into a cave that does not allow free and unimpeded passage of air, water, and cave life;

(7) Excavate or remove historic or prehistoric ruins, burial grounds, or archaeological or paleontological sites found in a cave, including, without limitation, saltpeter workings, relics, inscriptions, fossilized footprints, and bones;

(8) Remove, kill, harm, or disturb any cave life found within a cave.

(B) Without the express written permission of the owner and, if the owner has leased the land, without the express written permission of the lessee, no person shall purposely destroy, injure, or deface historic or prehistoric ruins, burial grounds, or archaeological or paleontological sites found in a cave, including, without limitation, saltpeter workings, relics, inscriptions, fossilized footprints, and bones.

Effective Date: 03-22-1989

### **1517.25 Sale of speleothems collected from caves prohibited**

No person shall sell or offer for sale speleothems collected from caves in this state.

Effective Date: 03-22-1989

### **1517.26 Immunity**

(A) Owners and, if the owner has leased the land, the lessee, are not liable for injuries, death, or loss sustained by any permittee on their land if no charge has been made. By granting permission for entry, the owner or lessee does not:

- (1) Extend to the permittee any assurance that the premises are safe for such purposes;
  - (2) Confer on the permittee the legal status of an invitee or licensee to whom a duty of care is owed;
  - (3) Assume responsibility for or incur liability for any injury, death, or loss to person or property caused by an act or omission of a permittee.
- (B) This section does not limit the liability which otherwise exists for injury, death, or loss to persons or property caused by an act or omission of the owner or lessee as follows:

- (1) Negligent failure to warn the permittee against a hazard of which the owner or lessee had actual knowledge prior to the permittee's entry on the land;
- (2) Willful or wanton misconduct;
- (3) Intentionally tortious conduct.

Effective Date: 03-22-1989

### **1517.99 Penalty**

(A)(1) Except as provided in division (A)(2) of this section, whoever violates section 1517.021 of the Revised Code is guilty of a minor misdemeanor.

(2) Whoever violates section 1517.021 of the Revised Code with regard to a species of plant identified in a rule adopted under or included on a list prepared under section 1518.01 of the Revised Code is guilty of a misdemeanor of the third degree for a first offense. For each subsequent offense, the person is guilty of a misdemeanor of the second degree.

(B) Whoever violates division (A) of section 1517.24 or section 1517.25 of the Revised Code is guilty of a misdemeanor of the third degree.

(C) Whoever violates division (B) of section 1517.24 of the Revised Code is guilty of a misdemeanor of the second degree.

(D) Whoever violates section 1517.051 of the Revised Code is guilty of a misdemeanor of the first degree.

Effective Date: 03-18-1999

**Old Woman Creek NERR  
Management Plan**

**APPENDIX D**

**Ohio Revised Code Chapter 1531  
Relating to wildlife laws of Ohio**

## **APPENDIX D. OHIO REVISED CODE (ORC) CHAPTER 1531: WILDLIFE LAWS OF OHIO**

### 1531.01 Division of Wildlife definitions

As used in this chapter and Chapter 1533. of the Revised Code:

(A) "Person" means a person as defined in section 1.59 of the Revised Code or a company; an employee, agent, or officer of such a person or company; a combination of individuals; the state; a political subdivision of the state; an interstate body created by a compact; or the federal government or a department, agency, or instrumentality of it.

(B) "Resident" means any individual who has resided in this state for not less than six months next preceding the date of making application for a license.

(C) "Nonresident" means any individual who does not qualify as a resident.

(D) "Division rule" or "rule" means any rule adopted by the chief of the division of wildlife under section 1531.10 of the Revised Code unless the context indicates otherwise.

(E) "Closed season" means that period of time during which the taking of wild animals protected by this chapter and Chapter 1533. of the Revised Code is prohibited.

(F) "Open season" means that period of time during which the taking of wild animals protected by this chapter and Chapter 1533. of the Revised Code is permitted.

(G) "Take or taking" includes pursuing, shooting, hunting, killing, trapping, angling, fishing with a trotline, or netting any clam, mussel, crayfish, aquatic insect, fish, frog, turtle, wild bird, or wild quadruped, and any lesser act, such as wounding, or placing, setting, drawing, or using any other device for killing or capturing any wild animal, whether it results in killing or capturing the animal or not. "Take or taking" includes every attempt to kill or capture and every act of assistance to any other person in killing or capturing or attempting to kill or capture a wild animal.

(H) "Possession" means both actual and constructive possession and any control of things referred to.

(I) "Bag limit" means the number, measurement, or weight of any kind of crayfish, aquatic insects, fish, frogs, turtles, wild birds, and wild quadrupeds permitted to be taken.

(J) "Transport and transportation" means carrying or moving or causing to be carried or moved.

(K) "Sell and sale" means barter, exchange, or offer or expose for sale.

(L) "Whole to include part" means that every provision relating to any wild animal protected by this chapter and Chapter 1533. of the Revised Code applies to any part of the wild animal with the same effect as it applies to the whole.

(M) "Angling" means fishing with not more than two hand lines, not more than two units of rod and line, or a combination of not more than one hand line and one rod and line, either in hand or under control at any time while fishing. The hand line or rod and line shall have attached to it not more than three baited hooks, not more than three artificial fly rod lures, or one artificial bait casting lure equipped with not more than three sets of three hooks each.



(N) "Trotline" means a device for catching fish that consists of a line having suspended from it, at frequent intervals, vertical lines with hooks attached.

(O) "Fish" means a cold-blooded vertebrate having fins.

(P) "Measurement of fish" means length from the end of the nose to the longest tip or end of the tail.

(Q) "Wild birds" includes game birds and nongame birds.

(R) "Game" includes game birds, game quadrupeds, and fur-bearing animals.

(S) "Game birds" includes mourning doves, ringneck pheasants, bobwhite quail, ruffed grouse, sharp-tailed grouse, pinnated grouse, wild turkey, Hungarian partridge, Chukar partridge, woodcocks, black-breasted plover, golden plover, Wilson's snipe or jacksnipe, greater and lesser yellowlegs, rail, coots, gallinules, duck, geese, brant, and crows.

(T) "Nongame birds" includes all other wild birds not included and defined as game birds or migratory game birds.

(U) "Wild quadrupeds" includes game quadrupeds and fur-bearing animals.

(V) "Game quadrupeds" includes cottontail rabbits, gray squirrels, black squirrels, fox squirrels, red squirrels, flying squirrels, chipmunks, groundhogs or woodchucks, white-tailed deer, wild boar, and black bears.

(W) "Fur-bearing animals" includes minks, weasels, raccoons, skunks, opossums, muskrats, fox, beavers, badgers, otters, coyotes, and bobcats.

(X) "Wild animals" includes mollusks, crustaceans, aquatic insects, fish, reptiles, amphibians, wild birds, wild quadrupeds, and all other wild mammals, but does not include domestic deer.

(Y) "Hunting" means pursuing, shooting, killing, following after or on the trail of, lying in wait for, shooting at, or wounding wild birds or wild quadrupeds while employing any device commonly used to kill or wound wild birds or wild quadrupeds whether or not the acts result in killing or wounding. "Hunting" includes every attempt to kill or wound and every act of assistance to any other person in killing or wounding or attempting to kill or wound wild birds or wild quadrupeds.

(Z) "Trapping" means securing or attempting to secure possession of a wild bird or wild quadruped by means of setting, placing, drawing, or using any device that is designed to close upon, hold fast, confine, or otherwise capture a wild bird or wild quadruped whether or not the means results in capture. "Trapping" includes every act of assistance to any other person in capturing wild birds or wild quadrupeds by means of the device whether or not the means results in capture.

(AA) "Muskrat spear" means any device used in spearing muskrats.

(BB) "Channels and passages" means those narrow bodies of water lying between islands or between an island and the mainland in Lake Erie.

(CC) "Island" means a rock or land elevation above the waters of Lake Erie having an area of five or more acres above water.

(DD) "Reef" means an elevation of rock, either broken or in place, or gravel shown by the latest United States chart to be above the common level of the surrounding bottom of the lake, other than the rock bottom, or in place forming the base or foundation rock of an island or mainland and sloping from the

shore of it. "Reef" also means all elevations shown by that chart to be above the common level of the sloping base or foundation rock of an island or mainland, whether running from the shore of an island or parallel with the contour of the shore of an island or in any other way and whether formed by rock, broken or in place, or from gravel.

(EE) "Fur farm" means any area used exclusively for raising fur-bearing animals or in addition thereto used for hunting game, the boundaries of which are plainly marked as such.

(FF) "Waters" includes any lake, pond, reservoir, stream, channel, lagoon, or other body of water, or any part thereof, whether natural or artificial.

(GG) "Crib" or "car" refers to that particular compartment of the net from which the fish are taken when the net is lifted.

(HH) "Commercial fish" means those species of fish permitted to be taken, possessed, bought, or sold unless otherwise restricted by the Revised Code or division rule and are alewife (*Alosa pseudoharengus*), American eel (*Anguilla rostrata*), bowfin (*Amia calva*), burbot (*Lota lota*), carp (*Cyprinus carpio*), smallmouth buffalo (*Ictiobus bubalus*), bigmouth buffalo (*Ictiobus cyprinellus*), black bullhead (*Ictalurus melas*), yellow bullhead (*Ictalurus natalis*), brown bullhead (*Ictalurus nebulosus*), channel catfish (*Ictalurus punctatus*), flathead catfish (*Pylodictis olivaris*), whitefish (*Coregonus* sp.), cisco (*Coregonus* sp.), freshwater drum or sheepshead (*Aplodinotus grunniens*), gar (*Lepisosteus* sp.), gizzard shad (*Dorosoma cepedianum*), goldfish (*Carassius auratus*), lake trout (*Salvelinus namaycush*), mooneye (*Hiodon tergisus*), quillback (*Carpiodes cyprinus*), smelt (*Allosmerus elongatus*, *Hypomesus* sp., *Osmerus* sp., *Spirinchus* sp.), sturgeon (*Acipenser* sp., *Scaphirhynchus* sp.), sucker other than buffalo and quillback (*Carpiodes* sp., *Catostomus* sp., *Hypentelium* sp., *Minytrema* sp., *Moxostoma* sp.), white bass (*Morone chrysops*), white perch (*Roccus americanus*), and yellow perch (*Perca flavescens*). When the common name of a fish is used in this chapter or Chapter 1533. of the Revised Code, it refers to the fish designated by the scientific name in this definition.

(II) "Fishing" means taking or attempting to take fish by any method, and all other acts such as placing, setting, drawing, or using any device commonly used to take fish whether resulting in a taking or not.

(JJ) "Fillet" means the pieces of flesh taken or cut from both sides of a fish, joined to form one piece of flesh.

(KK) "Part fillet" means a piece of flesh taken or cut from one side of a fish.

(LL) "Round" when used in describing fish means with head and tail intact.

(MM) "Migrate" means the transit or movement of fish to or from one place to another as a result of natural forces or instinct and includes, but is not limited to, movement of fish induced or caused by changes in the water flow.

(NN) "Spreader bar" means a brail or rigid bar placed across the entire width of the back, at the top and bottom of the cars in all trap, crib, and fyke nets for the purpose of keeping the meshes hanging squarely while the nets are fishing.

(OO) "Fishing guide" means any person who, for consideration or hire, operates a boat, rents, leases, or otherwise furnishes angling devices, ice fishing shanties or shelters of any kind, or other fishing equipment, and accompanies, guides, directs, or assists any other person in order for the other person to engage in fishing.

(PP) "Net" means fishing devices with meshes composed of twine or synthetic material and includes, but is not limited to, trap nets, fyke nets, crib nets, carp aprons, dip nets, and seines, except minnow seines and minnow dip nets.

(QQ) “Commercial fishing gear” means seines, trap nets, fyke nets, dip nets, carp aprons, trotlines, other similar gear, and any boat used in conjunction with that gear, but does not include gill nets.

(RR) “Native wildlife” means any species of the animal kingdom indigenous to this state.

(SS) “Gill net” means a single section of fabric or netting seamed to a float line at the top and a lead line at the bottom, which is designed to entangle fish in the net openings as they swim into it.

(TT) “Tag fishing tournament” means a contest in which a participant pays a fee, or gives other valuable consideration, for a chance to win a prize by virtue of catching a tagged or otherwise specifically marked fish within a limited period of time.

(UU) “Tenant” means an individual who resides on land for which the individual pays rent and whose annual income is primarily derived from agricultural production conducted on that land, as “agricultural production” is defined in section 929.01 of the Revised Code.

(VV) “Nonnative wildlife” means any wild animal not indigenous to this state, but does not include domestic deer.

(WW) “Reptiles” includes common musk turtle (*sternotherus odoratus*), common snapping turtle (*Chelydra serpentina serpentina*), spotted turtle (*Clemmys guttata*), eastern box turtle (*Terrapene carolina carolina*), Blanding’s turtle (*Emydoidea blandingii*), common map turtle (*Graptemys geographica*), ouachita map turtle (*Graptemys pseudogeographica ouachitensis*), midland painted turtle (*Chrysemys picta marginata*), red-eared slider (*Trachemys scripta elegans*), eastern spiny softshell turtle (*Apalone spinifera spinifera*), midland smooth softshell turtle (*Apalone mutica mutica*), northern fence lizard (*Sceloporus undulatus hyacinthinus*), ground skink (*Scincella lateralis*), five-lined skink (*Eumeces fasciatus*), broadhead skink (*Eumeces laticeps*), northern coal skink (*Eumeces anthracinus anthracinus*), European wall lizard (*Podarcis muralis*), queen snake (*Regina septemvittata*), Kirtland’s snake (*Clonophis kirtlandii*), northern water snake (*Nerodia sipedon sipedon*), Lake Erie watersnake (*Nerodia sipedon insularum*), copperbelly water snake (*Nerodia erythrogaster neglecta*), northern brown snake (*Storeria dekayi dekayi*), midland brown snake (*Storeria dekayi wrightorum*), northern redbelly snake (*Storeria occipitomaculata occipitomaculata*), eastern garter snake (*Thamnophis sirtalis sirtalis*), eastern plains garter snake (*Thamnophis radix radix*), Butler’s garter snake (*Thamnophis butleri*), shorthead garter snake (*Thamnophis brachystoma*), eastern ribbon snake (*Thamnophis sauritus sauritus*), northern ribbon snake (*Thamnophis sauritus septentrionalis*), eastern hognose snake (*Heterodon platirhinos*), eastern smooth earth snake (*Virginia valeriae valeriae*), northern ringneck snake (*Diadophis punctatus edwardsii*), midwest worm snake (*Carphophis amoenus helenae*), eastern worm snake (*Carphophis amoenus amoenus*), black racer (*Coluber constrictor constrictor*), blue racer (*Coluber constrictor foxii*), rough green snake (*Opheodrys aestivus*), smooth green snake (*Opheodrys vernalis vernalis*), black rat snake (*Elaphe obsoleta obsoleta*), eastern fox snake (*Elaphe vulpina gloydi*), black kingsnake (*Lampropeltis getula nigra*), eastern milk snake (*Lampropeltis triangulum triangulum*), northern copperhead (*Agkistrodon contortrix mokasen*), eastern massasauga (*Sistrurus catenatus catenatus*), and timber rattlesnake (*Crotalus horridus horridus*).

(XX) “Amphibians” includes eastern hellbender (*Cryptobranchus alleganiensis alleganiensis*), mudpuppy (*Necturus maculosus maculosus*), red-spotted newt (*Notophthalmus viridescens viridescens*), Jefferson salamander (*Ambystoma jeffersonianum*), spotted salamander (*Ambystoma maculatum*), blue-spotted salamander (*Ambystoma laterale*), smallmouth salamander (*Ambystoma texanum*), streamside salamander (*Ambystoma barbouri*), marbled salamander (*Ambystoma opacum*), eastern tiger salamander (*Ambystoma tigrinum tigrinum*), northern dusky salamander (*Desmognathus fuscus fuscus*), mountain dusky salamander (*Desmognathus ochrophaeus*), redback salamander (*Plethodon cinereus*), ravine salamander (*Plethodon richmondi*), northern slimy salamander (*Plethodon glutinosus*), Wehrle’s salamander (*Plethodon wehrlei*), four-toed salamander (*Hemidactylium scutatum*), Kentucky spring salamander (*Gyrinophilus porphyriticus duryi*), northern spring salamander (*Gyrinophilus porphyriticus porphyriticus*), mud salamander (*Pseudotriton montanus*), northern red salamander (*Pseudotriton ruber ruber*), green salamander (*Aneides aeneus*), northern two-lined salamander (*Eurycea bislineata*), longtail salamander (*Eurycea longicauda*

longicauda), cave salamander (*Eurycea lucifuga*), southern two-lined salamander (*Eurycea cirrigera*), Fowler's toad (*Bufo woodhousii fowleri*), American toad (*Bufo americanus*), eastern spadefoot (*Scaphiopus holbrookii*), Blanchard's cricket frog (*Acris crepitans blanchardi*), northern spring peeper (*Pseudacris crucifer crucifer*), gray treefrog (*Hyla versicolor*), Cope's gray treefrog (*Hyla chrysoscelis*), western chorus frog (*Pseudacris triseriata triseriata*), mountain chorus frog (*Pseudacris brachyphona*), bullfrog (*Rana catesbeiana*), green frog (*Rana clamitans melanota*), northern leopard frog (*Rana pipiens*), pickerel frog (*Rana palustris*), southern leopard frog (*Rana utricularia*), and wood frog (*Rana sylvatica*).

(YY) "Deer" means white-tailed deer (*Odocoileus virginianus*).

(ZZ) "Domestic deer" means nonnative deer that have been legally acquired or their offspring and that are held in private ownership for primarily agricultural purposes.

(AAA) "Migratory game bird" includes waterfowl (*Anatidae*); doves (*Columbidae*); cranes (*Gruidae*); cormorants (*Phalacrocoracidae*); rails, coots, and gallinules (*Rallidae*); and woodcock and snipe (*Scolopacidae*).

(BBB) "Accompany" means to go along with another person while staying within a distance from the person that enables uninterrupted, unaided visual and auditory communication.

(CCC) "Electric-powered all-purpose vehicle" means any battery-powered self-propelled electric vehicle that is designed primarily for cross-country travel on land, water, or land and water and that is steered by wheels, caterpillar treads, or a combination of wheels and caterpillar treads and includes vehicles that operate on a cushion of air, vehicles commonly known as all-terrain vehicles, all-season vehicles, mini-bikes, and trail bikes. "Electric-powered all-purpose vehicle" does not include a utility vehicle as defined in section 4501.01 of the Revised Code, any vehicle that is principally used in playing golf, any motor vehicle or aircraft that is required to be registered under Chapter 4503. or 4561. of the Revised Code, or any vehicle that is excluded from the definition of "motor vehicle" as provided in division (B) of section 4501.01 of the Revised Code.

Effective Date: 07-01-2003; 05-17-2006; 04-06-2007; 2008 SB209 06-25-2008

### [1531.02 State ownership of and title to wild animals - prohibited activities](#)

The ownership of and the title to all wild animals in this state, not legally confined or held by private ownership legally acquired, is in the state, which holds such title in trust for the benefit of all the people. Individual possession shall be obtained only in accordance with the Revised Code or division rules. No person at any time of the year shall take in any manner or possess any number or quantity of wild animals, except wild animals that the Revised Code or division rules permit to be taken, hunted, killed, or had in possession, and only at the time and place and in the manner that the Revised Code or division rules prescribe. No person shall buy, sell, or offer any part of wild animals for sale, or transport any part of wild animals, except as permitted by the Revised Code or division rules. No person shall possess or transport a wild animal that has been taken or possessed unlawfully outside the state.

A person doing anything prohibited or neglecting to do anything required by this chapter or Chapter 1533. of the Revised Code or contrary to any division rule violates this section. A person who counsels, aids, shields, or harbors an offender under those chapters or any division rule, or who knowingly shares in the proceeds of such a violation, or receives or possesses any wild animal in violation of the Revised Code or division rule, violates this section.

Effective Date: 06-01-1998; 04-06-2007

### [1531.021, 1531.022 Repealed](#)

Effective Date: 08-14-2002

### 1531.03 Division of Wildlife - Wildlife Council

There is hereby created within the department of natural resources a division of wildlife and a wildlife council.

The council shall have eight members, not more than four of whom shall be of the same political party, who shall be appointed by the governor with the advice and consent of the senate and shall be persons interested in the conservation of the natural resources of the state. At least two of the eight members shall be engaged in farming as their principal means of support. Terms of office shall be for four years, commencing on the first day of February and ending on the thirty-first day of January. Each member shall hold office from the date of his appointment until the end of the term for which he was appointed. In the event of the death, removal, resignation, or incapacity of a member of the council, the governor, with the advice and consent of the senate, shall appoint a successor who shall hold office for the remainder of the term for which his predecessor was appointed. Any member shall continue in office subsequent to the expiration date of his term until his successor takes office, or until a period of sixty days has elapsed, whichever occurs first.

The council shall hold at least four regular quarterly meetings each year. Special meetings may be held at the behest of the chairman or a majority of the members. The council shall annually select from among its members a chairman, a vice-chairman, and a secretary to keep a record of its proceedings.

The governor may at any time remove any member of the council for misfeasance, nonfeasance, or malfeasance in office.

A majority vote of the members of the council is necessary in all matters.

The division shall cooperate with the other divisions of the department and with all agencies of the state and federal government for the promotion of a general program of conservation.

All division rules relating to establishment of seasons, bag limits, size, species, method of taking, and possession shall be adopted only upon approval of the wildlife council. The wildlife council shall not approve or disapprove such rules prior to fifteen days following a public hearing held upon the rules in accordance with Chapter 119. of the Revised Code.

The wildlife council shall do all of the following:

(A) Be represented by not less than three of its members at all public hearings held pursuant to Chapter 119. of the Revised Code for the purpose of establishment of seasons, bag limits, size, species, methods of taking, and possession;

(B) Advise on policies of the division and the planning, development, and institution of programs and policies of the division;

(C) Investigate, consider, and make recommendations in all matters pertaining to the protection, preservation, propagation, possession, and management of wild animals throughout the state, as provided in this chapter and Chapter 1533. of the Revised Code;

(D) Report to the governor from time to time the results of its investigations concerning the wildlife resources of the state with recommendations of such measures as it considers necessary or suitable to conserve or develop those resources and preserve them as far as practicable.

Effective Date: 10-20-1994

#### 1531.04 Division of Wildlife - powers and duties

The division of wildlife, at the direction of the chief of the division, shall do all of the following:

(A) Plan, develop, and institute programs and policies based on the best available information, including biological information derived from professionally accepted practices in wildlife and fisheries management, with the approval of the director of natural resources;

(B) Have and take the general care, protection, and supervision of the wildlife in the state parks known as Lake St. Marys, The Portage Lakes, Lake Loramie, Indian Lake, Buckeye Lake, Guilford Lake, such part of Pymatuning reservoir as lies in this state, and all other state parks and lands owned by the state or in which it is interested or may acquire or become interested, except lands and lakes the care and supervision of which are vested in some other officer, body, board, association, or organization;

(C) Enforce by proper legal action or proceeding the laws of the state and division rules for the protection, preservation, propagation, and management of wild animals and sanctuaries and refuges for the propagation of those wild animals, and adopt and carry into effect such measures as it considers necessary in the performance of its duties;

(D) Promote, educate, and inform the citizens of the state about conservation and the values of fishing, hunting, and trapping, with the approval of the director.

Effective Date: 10-20-1994; 04-06-2007

#### 1531.05 Compensation

The members of the wildlife council shall receive no compensation for their services, but shall be paid the actual and necessary expenses incurred in the performance of their official duties.

The chief of the division of wildlife, in addition to the salary provided by law, shall be paid his actual and necessary expenses incurred in the performance of his official duties. He shall devote his entire time to the duties of his office, and shall hold no other office or position of profit.

Employees may be allowed and paid all actual and necessary expenses incurred by them in the performance of their duties, but only when itemized statements of such expenses are certified by the persons incurring the expense and are allowed by the chief.

Effective Date: 10-01-1953

#### 1531.06 Chief of Division - powers and duties

(A) The chief of the division of wildlife, with the approval of the director of natural resources, may acquire by gift, lease, purchase, or otherwise lands or surface rights upon lands and waters or surface rights upon waters for wild animals, fish or game management, preservation, propagation, and protection, outdoor and nature activities, public fishing and hunting grounds, and flora and fauna preservation. The chief, with the approval of the director, may receive by grant, devise, bequest, donation, or assignment evidences of indebtedness, the proceeds of which are to be used for the purchase of such lands or surface rights upon lands and waters or surface rights upon waters.

(B)(1) The chief shall adopt rules for the protection of state-owned or leased lands and waters and property under the control of the division of wildlife against wrongful use or occupancy that will ensure the carrying out of the intent of this section, protect those lands, waters, and property from depredations, and preserve them from molestation, spoliation, destruction, or any improper use or

occupancy thereof, including rules with respect to recreational activities and for the government and use of such lands, waters, and property.

(2) The chief may adopt rules benefiting wild animals, fish or game management, preservation, propagation, and protection, outdoor and nature activities, public fishing and hunting grounds, and flora and fauna preservation, and regulating the taking and possession of wild animals on any lands or waters owned or leased or under the division's supervision and control and, for a specified period of years, may prohibit or recall the taking and possession of any wild animal on any portion of such lands or waters. The division clearly shall define and mark the boundaries of the lands and waters owned or leased or under its supervision and control upon which the taking of any wild animal is prohibited.

(C) The chief, with the approval of the director, may acquire by gift, lease, or purchase land for the purpose of establishing state fish hatcheries and game farms and may erect on it buildings or structures that are necessary.

The title to or lease of such lands and waters shall be taken by the chief in the name of the state. The lease or purchase price of all such lands and waters may be paid from hunting and trapping and fishing licenses and any other funds.

(D) To provide more public recreation, stream and lake agreements for public fishing only may be obtained under rules adopted by the chief.

(E) The chief, with the approval of the director, may establish user fees for the use of special public facilities or participation in special activities on lands and waters administered by the division. The special facilities and activities may include hunting or fishing on special designated public lands and waters intensively managed or stocked with artificially propagated game birds or fish, field trial facilities, wildlife nature centers, firearm ranges, boat mooring facilities, camping sites, and other similar special facilities and activities. The chief shall determine whether the user fees are refundable and shall ensure that that information is provided at the time the user fees are paid.

(F) The chief, with the approval of the director, may enter into lease agreements for rental of concessions or other special projects situated on state-owned or leased lands or waters or other property under the division's control. The chief shall set and collect the fees for concession rentals or other special projects; regulate through contracts between the division and concessionaires the sale of tangible objects at concessions or other special projects; and keep a record of all such fee payments showing the amount received, from whom received, and for what purpose the fee was collected.

(G) The chief may sell or donate conservation-related items or items that promote wildlife conservation, including, but not limited to, stamps, pins, badges, books, bulletins, maps, publications, calendars, and any other educational article or artifact pertaining to wild animals; sell confiscated or forfeited items; and sell surplus structures and equipment, and timber or crops from lands owned, administered, leased, or controlled by the division. The chief, with the approval of the director, also may engage in campaigns and special events that promote wildlife conservation by selling or donating wildlife-related materials, memberships, and other items of promotional value.

(H) The chief may sell, lease, or transfer minerals or mineral rights, with the approval of the director, when the chief and the director determine it to be in the best interest of the state. Upon approval of the director, the chief may make, execute, and deliver contracts, including leases, to mine, drill, or excavate iron ore, stone, coal, petroleum, gas, salt, and other minerals upon and under lands owned by the state and administered by the division to any person who complies with the terms of such a contract. No such contract shall be valid for more than fifty years from its effective date. Consideration for minerals and mineral rights shall be by rental or royalty basis as prescribed by the chief and payable as prescribed by contract. Moneys collected under this division shall be paid into the state treasury to the credit of the wildlife habitat fund created in section 1531.33 of the Revised Code. Contracts entered into under this division also may provide for consideration for minerals or mineral rights in the form of acquisition of lands as provided under divisions (A) and (C) of this section.

(I) All moneys received under divisions (E), (F), and (G) of this section shall be paid into the state treasury to the credit of a fund that shall be used for the purposes outlined in section 1533.15 of the Revised Code and for the management of other wild animals for their ecological and nonconsumptive recreational value or benefit.

(J) The chief, with the approval of the director, may barter or sell wild animals to other states, state or federal agencies, and conservation or zoological organizations. Moneys received from the sale of wild animals shall be deposited into the wild animal fund created in section 1531.34 of the Revised Code.

(K) The chief shall adopt rules establishing standards and guidelines for the administration of contraceptive chemicals to noncaptive wild animals. The rules may specify chemical delivery methods and devices and monitoring requirements.

The chief shall establish criteria for the issuance of and shall issue permits for the administration of contraceptive chemicals to noncaptive wild animals. No person shall administer contraceptive chemicals to noncaptive wild animals without a permit issued by the chief.

(L) All fees set by the chief under this section shall be approved by the wildlife council.

(M) Information contained in the wildlife diversity database that is established pursuant to division (B)(2) of this section and section 1531.25 of the Revised Code may be made available to any individual or public or private agency for research, educational, environmental, land management, or other similar purposes that are not detrimental to the conservation of a species or feature. Information regarding sensitive site locations of species that are listed pursuant to section 1531.25 of the Revised Code and of features that are included in the wildlife diversity database is not subject to section 149.43 of the Revised Code if the chief determines that the release of the information could be detrimental to the conservation of a species or feature.

Effective Date: 03-18-1999; 04-06-2007; 2007 HB119 09-29-2007

### 1531.07 Jurisdiction

All lakes, reservoirs, and state lands dedicated to the use of the public for park and pleasure resort purposes shall be under the supervision and control of the chief of the division of wildlife with respect to the enforcement of all laws relating to the protection of birds, fish, and game. All laws for the protection of fish in inland rivers and streams of the state, and all laws for the protection of the birds, fish, and game and fur-bearing animals, shall apply to all such state reservoirs and lakes. No person shall disturb, injure, or destroy a tree, plant, lawn, embankment, decoration, or other property or kill, injure, or disturb a waterfowl, water animal, bird, or game or fur-bearing animal, kept as a semidomestic pet upon an island or within the boundary lines of Buckeye Lake, Indian Lake, The Portage Lakes, Lake St. Marys, Guilford Lake, and Lake Loramie, or any other territory over which the state has jurisdiction or an embankment or state land adjacent thereto. No person shall take or disturb fish in any lagoon or any other portion of any of the waters over which the state has jurisdiction and which have been set aside by the chief for the propagation of fish.

Effective Date: 09-30-1963

### 1531.08 Chief of division - powers and authority regarding wild animals

In conformity with Section 36 of Article II, Ohio Constitution, providing for the passage of laws for the conservation of the natural resources of the state, including streams, lakes, submerged lands, and swamplands, and in conformity with this chapter and Chapter 1533. of the Revised Code, the chief of the division of wildlife has authority and control in all matters pertaining to the protection, preservation, propagation, possession, and management of wild animals and may adopt rules under section 1531.10 of the Revised Code for the management of wild animals. Notwithstanding division (B) of



section 119.03 of the Revised Code, such rules in proposed form shall be filed under this section. Each year there shall be a public fish hearing and public game hearing. The results of the investigation and public hearing shall be filed in the office of the chief and shall be kept open for public inspection during all regular office hours. Modifying or rescinding such rules does not require a public hearing.

The chief may adopt, amend, rescind, and enforce rules throughout the state or in any part or waters thereof as provided by sections 1531.08 to 1531.12 and other sections of the Revised Code. The rules shall be filed in proposed form and available at the central wildlife office and at each of the wildlife district offices, including the Lake Erie unit located at Sandusky, at least thirty days prior to the date of the hearing required by division (C) of section 119.03 of the Revised Code. The rules shall be based upon a public hearing and investigation of the best available biological information derived from professionally accepted practices in wildlife and fisheries management.

Each rule adopted under this section shall clearly and distinctly describe and set forth the waters or area or part thereof affected by the rule and whether the rule is applicable to all wild animals or only to certain kinds of species designated therein.

The chief may regulate any of the following:

- (A) Taking and possessing wild animals, at any time and place or in any number, quantity, or length, and in any manner, and with such devices as he prescribes;
- (B) Transportation of such animals or any part thereof;
- (C) Buying, selling, offering for sale, or exposing for sale any such animal or part thereof;
- (D) Taking, possessing, transporting, buying, selling, offering for sale, and exposing for sale commercial fish or any part thereof, including species taken, length, weight, method of taking, mesh sizes, specifications of nets and other fishing devices, seasons, and time and place of taking.

When the chief increases the size of a fish named in section 1533.63 of the Revised Code, any fish that were legally taken, caught, or possessed prior to the increase may be possessed after the increase if the possession of the fish has been reported to the chief prior to the increase, but on or after the date of the increase the fish may not be sold to a buyer in this state.

Effective Date: 03-04-1998

#### [1531.081 Regulation of domestic deer](#)

The division of wildlife does not have authority to regulate domestic deer, which shall be regulated as agricultural animals by the department of agriculture.

Effective Date: 03-18-1999

#### [1531.09 Chief of division may amend or rescind rules after investigation](#)

If an investigation shows that any part of a rule of the division of wildlife should be modified for any cause not known, fully understood, or present at the time the rule was adopted, the chief of the division of wildlife may amend any part of the rule to meet the new condition or situation, but the amended rule shall be effective not longer than one year from its effective date.

If an investigation shows that such a rule or amended rule should be rescinded for any cause not known, fully understood, or present when the rule or amended rule was adopted, or due to a change in conditions making the rule or amended rule not necessary, the chief may rescind the rule or amended

rule and make it ineffective, except that if a rule or amended rule required the approval of the wildlife council for its adoption, it may be amended or rescinded only upon approval of the council.

Effective Date: 10-20-1994

#### 1531.10 Procedure for adoption, amendment and rescission of rules

As used in sections 1533.18 and 1533.181 of the Revised Code:

(A) "Premises" means all privately owned lands, ways, and waters, and any buildings and structures thereon, and all privately owned and state-owned lands, ways, and waters leased to a private person, firm, or organization, including any buildings and structures thereon.

(B) "Recreational user" means a person to whom permission has been granted, without the payment of a fee or consideration to the owner, lessee, or occupant of premises, other than a fee or consideration paid to the state or any agency of the state, or a lease payment or fee paid to the owner of privately owned lands, to enter upon premises to hunt, fish, trap, camp, hike, or swim, or to operate a snowmobile, all-purpose vehicle, or four-wheel drive motor vehicle, or to engage in other recreational pursuits.

(C) "All-purpose vehicle" has the same meaning as in section 4519.01 of the Revised Code.

Effective Date: 04-20-2000; 04-06-2007; 2007 SB77 10-10-2007

#### 1531.101 Rules for taking of migratory game birds

In addition to any other authority conferred on the chief of the division of wildlife, the chief may adopt rules under section 111.15 of the Revised Code that are necessary to establish acceptable methods of taking migratory game birds together with bag limits and designated seasons, areas, and hours for hunting them.

Effective Date: 08-14-2002

#### 1531.11 Violation of rules prohibited

No person shall take, kill, possess, transport, buy, or sell any wild animals contrary to any rule of the division of wildlife adopted in conformity with law.

Effective Date: 10-20-1994

#### 1531.12 Limitations on authority of chief

Nothing in sections 1531.08 to 1531.11 of the Revised Code shall be construed to authorize the chief of the division of wildlife to provide or change any penalty prescribed by law for a violation of its provisions, or to change the amount of any license fee or to provide license, except license fees when expressly permitted by a provision in Chapter 1531. or 1533. of the Revised Code.

Effective Date: 09-27-1974

### 1531.13 Wildlife officers

The law enforcement officers of the division of wildlife shall be known as "wildlife officers." The chief of the division of wildlife, wildlife officers, and such other employees of the division as the chief of the division of wildlife designates, and other officers who are given like authority, shall enforce all laws pertaining to the taking, possession, protection, preservation, management, and propagation of wild animals and all division rules. They shall enforce all laws against hunting without permission of the owner or authorized agent of the land on which the hunting is done. They may arrest on view and without issuance of a warrant. They may inspect any container or package at any time except when within a building and the owner or person in charge of the building objects. The inspection shall be only for bag limits of wild animals taken in open season or for wild animals taken during the closed season, or for any kind or species of those wild animals.

The chief may visit all parts of the state and direct and assist wildlife officers and other employees in the discharge of their duties. The owners or tenants of private lands or waters are not liable to wildlife officers for injuries suffered while carrying out their duties while on the lands or waters of the owners or tenants unless the injuries are caused by the willful or wanton misconduct of the owners or tenants. Any regularly employed salaried wildlife officer may enter any private lands or waters if the wildlife officer has good cause to believe and does believe that a law is being violated.

A wildlife officer, sheriff, deputy sheriff, constable, or officer having a similar authority may search any place which the officer has good reason to believe contains a wild animal or any part of a wild animal taken or had in possession contrary to law or division rule, or a boat, gun, net, seine, trap, ferret, or device used in the violation, and seize any the officer finds so taken or possessed. If the owner or person in charge of the place to be searched refuses to permit the search, upon filing an affidavit in accordance with law with a court having jurisdiction of the offense and upon receiving a search warrant issued, the officer forcibly may search the place described, and if in the search the officer finds any wild animal or part of a wild animal, or any boat, gun, net, seine, trap, ferret, or device in the possession of the owner or person in charge, contrary to this chapter or Chapter 1533. of the Revised Code or division rule, the officer shall seize it and arrest the person in whose custody or possession it was found. The wild animal or parts of a wild animal or boat, gun, net, seine, trap, ferret, or device so found shall escheat to the state.

Each wildlife officer shall post a bond in a sum not less than one thousand dollars executed by a surety company authorized to transact business in this state for the faithful performance of the duties of the wildlife officer's office.

The chief and wildlife officers have the authority specified under section 2935.03 of the Revised Code for peace officers of the department of natural resources for the purpose of enforcing the criminal laws of the state on any property owned, controlled, maintained, or administered by the department of natural resources and may enforce sections 2923.12, 2923.15, and 2923.16 of the Revised Code throughout the state and may arrest without warrant any person who, in the presence of the chief or any wildlife officer, is engaged in the violation of any of those laws.

A wildlife officer may render assistance to a state or local law enforcement officer at the request of that officer or may render assistance to a state or local law enforcement officer in the event of an emergency. Wildlife officers serving outside the division of wildlife under this section shall be considered as performing services within their regular employment for the purposes of compensation, pension or indemnity fund rights, workers' compensation, and other rights or benefits to which they may be entitled as incidents of their regular employment.

Wildlife officers serving outside the division of wildlife under this section retain personal immunity from civil liability as specified in section 9.86 of the Revised Code and shall not be considered an employee of a political subdivision for purposes of Chapter 2744. of the Revised Code. A political subdivision that uses wildlife officers under this section is not subject to civil liability under Chapter 2744. of the Revised Code as the result of any action or omission of any wildlife officer acting under this section.

Effective Date: 03-18-1999

[1531.131 Enforcing dumping prohibitions and nature preserve and trail rules](#)

A wildlife officer shall enforce section 3767.32 of the Revised Code and any other laws prohibiting the dumping of refuse into or along waters, the rules of the department of natural resources adopted under section 1517.02 of the Revised Code, and the rules of the director of natural resources adopted under Chapter 1519. of the Revised Code and shall make arrests for violation of those laws and rules. The jurisdiction of a wildlife officer is concurrent with that of the peace officers of the county, township, or municipal corporation in which the violation occurs.

Effective Date: 10-20-1994

[1531.132 Felony conviction precludes or terminates employment](#)

(A) As used in this section, "felony" has the same meaning as in section 109.511 of the Revised Code.

(B)(1) The chief of the division of wildlife shall not designate a person as a game protector on a permanent basis, on a temporary basis, for a probationary term, or on other than a permanent basis if the person previously has been convicted of or has pleaded guilty to a felony.

(2)(a) The chief of the division of wildlife shall terminate the employment of a person as a game protector if that person does either of the following:

(i) Pleads guilty to a felony;

(ii) Pleads guilty to a misdemeanor pursuant to a negotiated plea agreement as provided in division (D) of section 2929.43 of the Revised Code in which the game protector agrees to surrender the certificate awarded to the game protector under section 109.77 of the Revised Code.

(b) The chief shall suspend from employment as a game protector a person designated as a game protector if that person is convicted, after trial, of a felony. If the game protector files an appeal from that conviction and the conviction is upheld by the highest court to which the appeal is taken or if the game protector does not file a timely appeal, the chief shall terminate the employment of that game protector. If the game protector files an appeal that results in the game protector's acquittal of the felony or conviction of a misdemeanor, or in the dismissal of the felony charge against the game protector, the chief shall reinstate that game protector. A game protector who is reinstated under division (B)(2)(b) of this section shall not receive any back pay unless that game protector's conviction of the felony was reversed on appeal, or the felony charge was dismissed, because the court found insufficient evidence to convict the game protector of the felony.

(3) Division (B) of this section does not apply regarding an offense that was committed prior to January 1, 1997.

(4) The suspension from employment, or the termination of the employment, of a game protector under division (B)(2) of this section shall be in accordance with Chapter 119. of the Revised Code.

Effective Date: 01-01-2004

### 1531.133 Wildlife violators compact for joint enforcement operations

(A)(1) The chief of the division of wildlife, with the approval of the director of natural resources, may enter into a memorandum of understanding, agreement, or mutual aid compact with the head of any entity of another state, federal entity, or foreign entity that employs or appoints a law enforcement officer who has substantially the same duties as a peace officer, as "peace officer" is defined in section 2935.01 of the Revised Code, to enable wildlife officers and the specified law enforcement officers to assist each other in the provision of law enforcement services within the jurisdictions that are subject to the memorandum of understanding, agreement, or mutual aid compact.

(2) Employees of the division of wildlife who are serving under the terms of a memorandum of understanding, agreement, or mutual aid compact entered into under division (A)(1) of this section shall be considered as performing services within their regular employment for purposes of compensation, pension or indemnity fund rights, workers' compensation, and other rights or benefits to which they may be entitled as incidents of their regular employment.

(3) Employees of the division of wildlife who are serving under the terms of a memorandum of understanding, agreement, or mutual aid compact entered into under division (A)(1) of this section retain personal immunity from civil liability under section 9.86 of the Revised Code and all rights of indemnification and representation incident to regular employment.

(B) The chief shall adopt rules to enter into a reciprocal agreement with participating states for the enhancement of compliance with hunting, fishing, and other wildlife laws. The agreement is named the wildlife violators compact. The agreement and the rules shall provide for the fair and impartial treatment of wildlife violators operating within participating states in recognition of the violators' due process rights.

Effective Date: 2007 HB153 10-18-2007

### 1531.14 Right of entry on land for research or investigation

Any person regularly employed by the division of wildlife for the purpose of conducting research and investigation of game or fish or their habitat conditions or engaged in restocking game or fish or in any type of work involved in or incident to game or fish restoration projects or in the enforcement of laws or division rules relating to game or fish, or in the enforcement of section 1531.29 or 3767.32 of the Revised Code, other laws prohibiting the dumping of refuse in or along streams, or watercraft laws, while in the normal, lawful, and peaceful pursuit of such investigation, work, or enforcement may enter upon, cross over, be upon, and remain upon privately owned lands for such purposes and shall not be subject to arrest for trespass while so engaged or for such cause thereafter.

Any such person, upon demand, shall identify himself to the owner, tenant, or manager of such privately owned lands by means of a badge or card bearing his name and certifying his employment by the division.

Effective Date: 10-20-1994

### 1531.15 Division of wildlife may take fish

The division of wildlife may take fish at any time or place, in any manner, for the maintenance or cultivation of fish in hatcheries, or for the purpose of stocking ponds, lakes, rivers, or creeks, or for the purpose of exterminating rough fish in any waters. The division may set aside any waters for the propagation of fish or waterfowl.

Effective Date: 10-01-1953

### 1531.16 Enforcement and prosecution of wildlife laws and rules

Sheriffs, deputy sheriffs, constables, and other police officers shall enforce the laws and division rules for the taking, possession, protection, preservation, and propagation of wild animals and for this purpose shall have the power conferred upon wildlife officers. Prosecution for offenses not committed in the presence of an officer shall be instituted only upon the approval of the prosecuting attorney of the county in which the offense is committed, or a municipal legal officer within his territorial jurisdiction, or upon the approval of the attorney general, and when the services of counsel are necessary, the attorney authorized by this section to approve the action and who does so shall act as attorney for the prosecution of the case.

Effective Date: 10-20-1994

### 1531.17 Wildlife fund

All fines, penalties, and forfeitures arising from prosecutions, convictions, confiscations, or otherwise under this chapter and Chapters 1517. and 1533. of the Revised Code, unless otherwise directed by the director of natural resources, shall be paid by the officer by whom collected to the director and by him paid into the state treasury to the credit of the wildlife fund, which is hereby created, for the use of the division of wildlife. All moneys collected as license fees on nets in the Lake Erie fishing district shall be paid by the director into the state treasury to the credit of the wildlife fund for use only in the betterment and the propagation of fish therein or in otherwise propagating fish in such district. All investment earnings of the fund shall be credited to the fund. The wildlife fund shall not be used for compensation of personnel employed by other divisions of the department of natural resources who are assigned to law enforcement duties in aid of the division of wildlife or for compensation of division of wildlife personnel for activities related to the instruction of personnel of other divisions.

Effective Date: 01-10-1991

### 1531.18 Jurisdiction

Any judge of a county court or municipal court judge has final jurisdiction within the territory for which he is elected or appointed in a prosecution for any violation of this chapter or Chapter 1533. of the Revised Code, or division rules, and in a proceeding for forfeiture under those chapters or rules.

Effective Date: 10-20-1994

### 1531.19 Service of summons on corporations

When an affidavit is filed against a corporation for a violation of this chapter or Chapter 1533. of the Revised Code, a summons, returnable on or before the tenth day after its date, shall be issued directed to the sheriff, constable, or wildlife officer commanding him to notify the accused thereof. The summons together with a copy of the affidavit shall be served and returned in the manner provided for the service of summons upon corporations in civil actions. On or before the return day of the summons served, the corporation may appear by one of its officers or by counsel and answer the affidavit by

motion or plea, but upon failure to make an appearance and answer the clerk of the court shall enter a plea of "not guilty." Upon such an appearance being made or plea entered, the corporation shall be deemed present before the court until the cause is finally disposed of.

Effective Date: 10-20-1994

### 1531.20 Seizure of property or device used in unlawful taking or transporting of wild animals

Any motor vehicle, all-terrain vehicle, or boat used in the unlawful taking or transporting of wild animals, and any net, seine, trap, ferret, gun, or other device used in the unlawful taking of wild animals, is a public nuisance. Each wildlife officer, or other officer with like authority, shall seize and safely keep such property and the illegal results of its use, and unless otherwise ordered by the chief of the division of wildlife shall initiate, within thirty days, proceedings in a proper court of the county for its forfeiture. A writ of replevin shall not lie to take the property from the officer's custody or from the custody or jurisdiction of the court in which the proceeding is initiated, nor shall the proceeding affect a criminal prosecution for the unlawful use or possession of the property.

An action for the forfeiture of any such property shall be initiated by the filing of an affidavit describing the property seized and stating the unlawful use made of it, the time and place of seizure, and the name of the person owning or using it at the time of seizure. If the name is unknown, that fact shall be stated. Upon the filing of the affidavit, the court shall issue a summons setting forth the facts stated in the affidavit and fixing a time and place for the hearing of the complaint. A copy of the summons shall be served on the owner or person using the property at the time of its seizure, if the owner or user is known, or by leaving a copy thereof at the owner's or user's usual residence or place of business in the county, at least three days before the time fixed for the hearing of the complaint. If the owner or user is unknown or a nonresident of the county or cannot be found therein, a copy of the summons shall be posted at a suitable place nearest the place of seizure, but if the owner's or user's address is known, a copy of the summons shall be mailed to the owner or user at least three days before the time fixed for the hearing of the complaint. On the date fixed for the hearing, the officer making the service shall make a return of the time and manner of making the service. Upon the proper cause shown, the court may postpone the hearing.

A proceeding for the forfeiture of seized property that is initiated under this section shall not progress to actual forfeiture of the seized property unless so ordered by the court. The court may order the actual forfeiture of the seized property as part of the sentence that it imposes if the owner or person unlawfully using the property at the time of its seizure is convicted, pleads guilty, or confesses that the property at the time of its seizure was being used by the owner or user in violation of law or division rule. Forfeited property shall be the property of the state, to be disposed of as the chief of the division of wildlife directs.

Effective Date: 03-18-1999; 04-06-2007

### 1531.201 Civil action to recover possession or value of wild animal

(A) As used in this section:

(1) "Gross score" means the number derived by calculating the measurements of the antlers of a white-tailed deer in accordance with division (C)(2) of this section.

(2) "Point" means a projection on the antler of a white-tailed deer that is at least one-inch long as measured from its tip to the nearest edge of antler beam and the length of which exceeds the length of its base. "Point" does not include an antler beam tip.

(3) "Abnormal point" means a point that is nontypical in shape or location.

(4) "Normal point" means a point that projects from the main antler beam in a typical shape or location.

(5) "Inside spread of main antler beams" means the measurement at right angles to the center line of the skull of a white-tailed deer at the widest point between main antler beams.

(6) "Length of main antler beam" means the measurement from the lowest outside edge of the antler burr of a white-tailed deer over the outer curve to the most distant point of what is or appears to be the main antler beam beginning at the place on the antler burr where the center line along the outer curve of the beam intersects the antler burr.

(7) "Antler burr" means the elevated bony rim around the antler base of a white-tailed deer that is just above the skin of the pedicle.

(B) The chief of the division of wildlife or the chief's authorized representative may bring a civil action to recover possession of or the restitution value of any wild animal held, taken, bought, sold, or possessed in violation of this chapter or Chapter 1533. of the Revised Code or any division rule against any person who held, took, bought, sold, or possessed the wild animal.

The minimum restitution value to the state for wild animals that are unlawfully held, taken, bought, sold, or possessed shall be established in division rule.

(C)(1) In addition to any restitution value established in division rule, a person who is convicted of a violation of this chapter or Chapter 1533. of the Revised Code or a division rule governing the holding, taking, buying, sale, or possession of an antlered white-tailed deer with a gross score of more than one hundred twenty-five inches also shall pay an additional restitution value that is calculated using the following formula:

Additional restitution value = ((gross score – 100)? x \$1.65).

(2) The gross score of an antlered white-tailed deer shall be determined by taking and adding together all of the following measurements, which shall be made to the nearest one-eighth of an inch using a one-quarter-inch wide flexible steel tape:

(a) Inside spread of the main antler beams, not to exceed the length of the longest main antler beam;

(b) Length of the right main antler beam;

(c) Length of the left main antler beam;

(d) Total length of all abnormal points;

(e) Total length of all normal points as measured from the nearest edge of the main antler beam over the outer curve to the tip. To determine the baseline for normal point measurement, the tape shall be laid along the outer curve of the antler beam so that the top edge of the tape coincides with the top edge of the antler beam on both sides of the point.

(f) Circumference taken at the narrowest place between the antler burr and the first normal point on the right main antler beam. If the first normal point is missing, the circumference shall be taken at the narrowest place between the antler burr and the second normal point.

(g) Circumference taken at the narrowest place between the first normal point and the second normal point on the right main antler beam. If the first normal point is missing, the circumference shall be taken at the narrowest place between the antler burr and the second normal point.



(h) Circumference taken at the narrowest place between the second normal point and the third normal point on the right main antler beam;

(i) Circumference taken at the narrowest place between the third normal point and the fourth normal point on the right main antler beam. If the fourth normal point is missing, the circumference shall be taken halfway between the third normal point and the tip of the main antler beam.

(j) Circumference taken at the narrowest place between the antler burr and the first normal point on the left main antler beam. If the first normal point is missing, the circumference shall be taken at the narrowest place between the antler burr and the second normal point.

(k) Circumference taken at the narrowest place between the first normal point and the second normal point on the left main antler beam. If the first normal point is missing, the circumference shall be taken at the narrowest place between the antler burr and the second normal point.

(l) Circumference taken at the narrowest place between the second normal point and the third normal point on the left main antler beam;

(m) Circumference taken at the narrowest place between the third normal point and the fourth normal point on the left main antler beam. If the fourth normal point is missing, the circumference shall be taken halfway between the third normal point and the tip of the main antler beam.

Antlers may be measured at any time; no drying time is required.

(D) Upon conviction of holding, taking, buying, selling, or possessing a wild animal in violation of this chapter, Chapter 1533. of the Revised Code, or a division rule, the chief shall revoke until payment of the restitution value is made each hunting license, fur taker permit, deer permit, wild turkey permit, wetlands habitat stamp, and fishing license issued to that person under this chapter or Chapter 1533. of the Revised Code. No fee paid for such a license, permit, or stamp shall be returned to the person.

Upon revoking a person's license, permit, or stamp or a combination thereof under this division, the chief immediately shall send a notice of that action by certified mail to the last known address of the person. The notice shall state the action taken, order the person to surrender the revoked license, permit, or stamp or combination thereof, and state that the department of natural resources will not afford a hearing as required under section 119.06 of the Revised Code.

(E) Nothing in this section affects the right of seizure under any other section of the Revised Code.

Effective Date: 10-20-1994; 2007 HB238 03-04-2008

### [1531.202 Liability for costs incurred in investigation of death of wild animal](#)

Any person who is responsible for causing or allowing an unauthorized spill, release, or discharge of material into or on any land or any ground or surface water or into the air that results in the death of a wild animal and that necessitates an investigation by the division of wildlife, or who violates section 1531.02 of the Revised Code in a manner that necessitates an investigation by the division regarding the death of a wild animal, is liable to the division for costs incurred in the investigation if the person pleads guilty to or is convicted of causing or allowing the unauthorized spill, release, or discharge or a violation of section 1531.02 of the Revised Code. The costs may include wages and benefits of employees of the division. The chief of the division of wildlife or the chief's authorized representative shall bring a civil action against the responsible person to recover those costs.

Effective Date: 03-18-1999

### 1531.21 Trial procedure for forfeiture or condemnation

The defendant in a proceeding for forfeiture or condemnation under a division rule or this chapter or Chapter 1533. of the Revised Code shall be tried under the rules of criminal procedure and according to law.

Effective Date: 10-20-1994

### 1531.22 Payment of costs

A person authorized by law to prosecute a case under a division rule or this chapter or Chapter 1533. of the Revised Code shall not be required to advance or secure costs therein. If the defendant is acquitted or discharged from custody, the costs shall be certified under oath by the court to the chief of the division of wildlife, who shall correct all errors therein and pay the person entitled to payment out of the wildlife fund created in section 1531.17 of the Revised Code.

Effective Date: 10-20-1994

### 1531.23 Judgment for costs and fine or forfeiture - lien - failure to pay

If the defendant in a prosecution or condemnation proceeding under a division rule or this chapter or Chapter 1533. of the Revised Code is convicted, judgment shall be rendered against him for costs in addition to the fine imposed or forfeiture declared. The judgment shall be the first lien upon the property of the person convicted, and no exemption shall be claimed or allowed against that lien. If he fails to pay the fine and costs imposed or if execution issued is returned unsatisfied, the person convicted shall be committed to the county jail or to a workhouse and there confined one day for the amount of the fine adjudged against him, determined as provided in section 2747.14 of the Revised Code. The person convicted shall not be discharged or paroled therefrom by any board or officer except upon payment of the fine remaining unpaid or upon written permission of the chief of the division of wildlife.

Effective Date: 10-20-1994

### 1531.24 United States commissioner of fisheries authorized to establish, operate, and maintain fish hatcheries in Ohio

The United States commissioner of fisheries and his authorized agents may establish fish hatcheries in Ohio, and operate and maintain them. Such persons may acquire by lease, gift, or purchase lands and other equipment necessary for such purpose and conduct in any manner and at any time investigations and fish cultural operations as are considered necessary and proper.

Effective Date: 10-01-1953

### 1531.25 Protection of species threatened with statewide extinction

The chief of the division of wildlife, with the approval of the wildlife council, shall adopt and may modify and repeal rules, in accordance with Chapter 119. of the Revised Code, restricting the taking or possession of native wildlife, or any eggs or offspring thereof, that he finds to be threatened with statewide extinction. The rules shall identify the common and scientific names of each endangered species and shall be modified from time to time to include all species on the list of endangered fish and wildlife pursuant to Section 4 of the "Endangered Species Act of 1973," 87 Stat. 884, 16 U.S.C. 1531, as amended, and that are native to this state, or that migrate or are otherwise reasonably likely to occur within the state.

The rules shall provide for the taking of species threatened with statewide extinction, for zoological, educational, and scientific purposes, and for propagation in captivity to preserve the species, under written permits from the chief. The rules shall in no way restrict the taking or possession of species listed on such United States list for zoological, educational, or scientific purposes, or for propagation in captivity to preserve the species, under a permit or license from the United States or any instrumentality thereof.

No person shall violate any rule adopted pursuant to this section.

Effective Date: 07-20-1988

#### 1531.26 Nongame and endangered wildlife fund

There is hereby created in the state treasury the nongame and endangered wildlife fund, which shall consist of moneys paid into it by the tax commissioner under section 5747.113 of the Revised Code, moneys deposited in the fund from the issuance of wildlife conservation license plates under section 4503.57 of the Revised Code, moneys deposited in the fund from the issuance of bald eagle license plates under section 4503.572 of the Revised Code, moneys credited to the fund under section 1533.151 of the Revised Code, and contributions made directly to it. Any person may contribute directly to the fund in addition to or independently of the income tax refund contribution system established in section 5747.113 of the Revised Code. Moneys in the fund shall be disbursed pursuant to vouchers approved by the director of natural resources for use by the division of wildlife solely for the purchase, management, preservation, propagation, protection, and stocking of wild animals that are not commonly taken for sport or commercial purposes, including the acquisition of title and easements to lands, biological investigations, law enforcement, production of educational materials, sociological surveys, habitat development, and personnel and equipment costs; and for carrying out section 1531.25 of the Revised Code. Moneys in the fund also may be used to promote and develop nonconsumptive wildlife recreational opportunities involving wild animals. Moneys in the fund from the issuance of bald eagle license plates under section 4503.572 of the Revised Code shall be expended by the division only to pay the costs of acquiring, developing, and restoring habitat for bald eagles within this state. Moneys in the fund from any other source also may be used to pay the costs of acquiring, developing, and restoring habitat for bald eagles within this state.

All investment earnings of the fund shall be credited to the fund. Subject to the approval of the director, the chief of the division of wildlife may enter into agreements that the chief considers appropriate to obtain additional moneys for the protection of nongame native wildlife under the "Endangered Species Act of 1973," 87 Stat. 884, 16 U.S.C.A. 1541-1543, as amended, and the "Fish and Wildlife Conservation Act of 1980," 94 Stat. 1322, 16 U.S.C.A. 2901-2911, as amended. Moneys appropriated from the fund are not intended to replace other moneys appropriated for these purposes.

Effective Date: 09-26-2003

#### 1531.27 Payments to counties for land use by state

The chief of the division of wildlife shall pay to the treasurers of the several counties wherein lands owned by the state and administered by the division are located an annual amount determined in the following manner: in each such county one per cent of the total value of such lands exclusive of improvements, as shown on the auditor's records of taxable value of real property existing at the time when the state acquired the tract or tracts comprising the lands.

The payments shall be made from funds accruing to the division from fines, penalties, restitution, and forfeitures deposited into the state treasury to the credit of the wildlife fund created in section 1531.17 of the Revised Code. The allocation of amounts to be paid from those sources shall be determined by the director of natural resources.

The payments to the treasurers of the several counties shall be credited to the fund for school purposes within the school districts wherein the lands are located.

Effective Date: 09-30-1963; 09-29-2005; 04-06-2007

#### 1531.28 Contract with private persons for creation or improvement of wildlife habitat

The division of wildlife, in the management of lands owned, leased, or administered by it or under agreement with it, may contract with private persons for the creation or improvement of wildlife habitat thereon. Such a contract may be paid for in money, materials, services rendered, or goods produced incidentally to the contract, whichever is advantageous to the state.

Effective Date: 10-20-1994

#### 1531.29 Prohibiting polluting state land or water

No person shall place or dispose of in any manner, any garbage, waste, peelings of vegetables or fruits, rubbish, ashes, cans, bottles, wire, paper, cartons, boxes, parts of automobiles, wagons, furniture, glass, oil, or anything else of an unsightly or unsanitary nature on any state owned, controlled, or administered land, or in any ditch, stream, river, lake, pond, or other watercourse, except those waters which do not combine or effect a junction with natural surface or underground waters, or upon the bank thereof where the same is liable to be washed into the water either by ordinary flow or floods. This section does not apply to any substance placed under authority of a permit issued under section 6111.04 of the Revised Code or exempted by such section from its terms.

Effective Date: 11-20-1973

#### 1531.30 Cooperative management fund

There is hereby created in the state treasury the cooperative management fund. All revenue generated on land owned by the United States army corps of engineers and managed by the division of the wildlife of the department of natural resources pursuant to an agreement with the corps shall be credited to the fund. All money in the fund shall be spent for fish and wildlife management purposes and for the management and maintenance of the area managed by the division. All investment earnings of the fund shall be credited to the fund.

Effective Date: 03-13-1986

#### 1531.31 Ohio River management fund

The wildlife habitat fund is hereby created in the state treasury. The fund shall consist of the investment earnings of the wildlife habitat trust fund created in section 1531.32 of the Revised Code; gifts, donations, bequests, and other moneys contributed to the division of wildlife for the purposes of the fund; moneys collected under division (H) of section 1531.06 of the Revised Code; and moneys received by the division pursuant to negotiated mitigation settlements from persons who have adversely affected fish and wildlife, or their habitats, over which the division has jurisdiction under this chapter or Chapter 1533. of the Revised Code other than fish and wildlife of the Ohio river or their habitats.

The fund shall be used by the division to acquire and develop lands for the preservation, propagation, and protection of wild animals. All expenditures from the wildlife habitat fund shall be approved by the director of natural resources. Quarterly each fiscal year, the treasurer of state shall transfer the investment earnings of the wildlife habitat trust fund to the wildlife habitat fund.

Effective Date: 03-18-1999

#### 1531.32 Wildlife habitat trust fund

There is hereby created the wildlife habitat trust fund, which shall be in the custody of the treasurer of state and shall not be a part of the state treasury. The purpose of the fund is to facilitate the acquisition and development of lands for the preservation, propagation, and protection of wild animals. The fund shall consist of money received from gifts, donations, bequests, and other moneys contributed to the division of wildlife for the purposes of the fund. Investment earnings of the fund shall be retained by the fund until transferred to the wildlife habitat fund as required by section 1531.33 of the Revised Code. The principal of the wildlife habitat trust fund shall not be spent for any purpose.

Effective Date: 09-17-1991

#### 1531.33 Wildlife habitat fund

The wildlife habitat fund is hereby created in the state treasury. The fund shall consist of the investment earnings of the wildlife habitat trust fund created in section 1531.32 of the Revised Code; gifts, donations, bequests, and other moneys contributed to the division of wildlife for the purposes of the fund; moneys collected under division (H) of section 1531.06 of the Revised Code; and moneys received by the division pursuant to negotiated mitigation settlements from persons who have adversely affected fish and wildlife, or their habitats, over which the division has jurisdiction under this chapter or Chapter 1533. of the Revised Code other than fish and wildlife of the Ohio river or their habitats.

The fund shall be used by the division to acquire and develop lands for the preservation, propagation, and protection of wild animals. All expenditures from the wildlife habitat fund shall be approved by the director of natural resources. Quarterly each fiscal year, the treasurer of state shall transfer the investment earnings of the wildlife habitat trust fund to the wildlife habitat fund.

Effective Date: 03-18-1999

#### 1531.34 Wild animal fund

There is hereby created in the state treasury the wild animal fund. The fund shall consist of moneys received from the sale of wild animals under division (J) of section 1531.06 of the Revised Code. Moneys in the fund shall be spent on programs administered by the division of wildlife or contributed by the division to an appropriate nonprofit organization for the acquisition, development, and management of lands and waters within the state for wildlife purposes.

Effective Date: 03-18-1999

#### 1531.35 Wildlife boater angler fund

The wildlife boater angler fund is hereby created in the state treasury. The fund shall consist of money credited to the fund pursuant to section 5735.051 of the Revised Code and other money contributed to the division of wildlife for the purposes of the fund. The fund shall be used for boating access construction, improvements, and maintenance, and to pay for equipment and personnel costs involved with those activities, on lakes on which the operation of gasoline-powered watercraft is permissible.

However, not more than two hundred thousand dollars of the annual expenditures from the fund may be used to pay for the equipment and personnel costs.

Effective Date: 09-05-2001; 2007 HB119 09-29-2007

### 1531.99 Penalty

(A) Whoever violates section 1531.02 of the Revised Code, or any division rule, other than a rule adopted under section 1531.25 of the Revised Code, is guilty of a misdemeanor of the fourth degree.

(B) Whoever violates section 1531.02 of the Revised Code concerning the taking or possession of deer or violates division (K) of section 1531.06 or section 1531.07 or 1531.29 of the Revised Code is guilty of a misdemeanor of the third degree on a first offense; on each subsequent offense, that person is guilty of a misdemeanor of the first degree.

(C) Whoever violates section 1531.25 of the Revised Code is guilty of a misdemeanor of the first degree.

(D) Whoever violates section 1531.02 of the Revised Code concerning the buying, selling, or offering for sale of any wild animals or parts of wild animals, the minimum value of which animals or parts, in the aggregate, is one thousand dollars or more as established under section 1531.201 of the Revised Code, is guilty of a felony of the fifth degree.

(E) A court that imposes sentence for a violation of any section of this chapter governing the holding, taking, buying, selling, or possession of wild animals, including, without limitation, section 1531.11 of the Revised Code, may require the person who is convicted of or pleads guilty to the offense, in addition to any fine, term of imprisonment, seizure, and forfeiture imposed, to make restitution for the minimum value of the wild animal illegally held, taken, bought, sold, or possessed as established under section 1531.201 of the Revised Code. An officer who collects moneys paid as restitution under this section shall pay those moneys to the treasurer of state who shall deposit them in the state treasury to the credit of the wildlife fund established under section 1531.17 of the Revised Code.

Effective Date: 03-18-1999; 04-06-2007; 2007 HB238 03-04-2008

**Old Woman Creek NERR  
Management Plan**

**APPENDIX E**

**Research Completed at Old Woman Creek  
National Estuarine Research Reserve,  
Huron, Ohio**

## APPENDIX E. RESEARCH COMPLETED AT OLD WOMAN CREEK NATIONAL ESTUARINE RESEARCH RESERVE, HURON, OHIO

Arcand-Hoya, L.D. and C.D. Metcalf. 2000. Hepatic Macronuclei in Brown Bullheads (*Ameiurus nebulosus*) as a biomarker for exposure to Genotype. *J. Great Lakes Res.* 26(4): 408-415.

Baumann, P.C. 1992. Methodological considerations for conducting tumor surveys of fishes. *J. Aquat. Ecosyst. Health.* 1: 33-39.

\_\_\_\_\_. 1992. The use of tumors in wild populations of fish to assess ecosystem health. *J. Aquat. Ecosyst. Health.* 1: 135-146.

\_\_\_\_\_, and J.C. Harshbarger. 1995. Decline in Liver Neoplasms in wild Brown Bullhead Catfish after coking plant closes and environmental PAHs plummet. *Environ. Health Perspectives* 103: 168-170.

\_\_\_\_\_ and K.J. Hartman. 1990. Relationship between liver tumors and age in Brown Bullhead populations from two Lake Erie tributaries. *Sci. Total Environ.* 94: 71-87.

Bedford, K. W. 1989. The Effects of Lake Erie on its Tributaries- - Resulting Tributary Transport Mechanisms and Contrasts with Marine Estuaries. In: Lake Erie Estuarine Systems: Issues, Resources, Status, and Management (K. Krieger, ed.) NOAA Estuary-of-the-Month Seminar Series No.14. pp:71- 123.

\_\_\_\_\_, D. A. Lindsay, W.G. Mattox, and C.E. Herdendorf. 1983a. Analysis of Great Lakes Seiche Affected Estuary Transport. Vol. 1: A review of estuary hydraulics and transport as applied to rivers tributary to Lake Erie. U.S. Dept. Interior, Office Water Resources and Technology Contract No. 14-34-001-9128, Project Completion Report, Ohio State University, Water Resources Center, Columbus, OH 262 pp.

\_\_\_\_\_, L.D. Fisher, W.G. Mattox, and C.E. Herdendorf. 1983c. Analysis of Great Lakes Seiche Affected Estuary Transport. Vol. 3: A laterally averaged model of momentum and energy transport with application to seiche hydraulics. U.S. Dept. Interior, Office Water Resources and Technology Contract No. 14-34-001-9128, Project Completion Report, Ohio State University, Water Resources Center, Columbus, OH 178 pp. + 54 pp. model.

\_\_\_\_\_, M.C. Worthy, W.G. Mattox, and C.E. Herdendorf. 1983b. Analysis of Great Lakes Seiche Affected Estuary Transport. Vol. 2: Littoral drift at estuary mouths- a case study at Old Woman Creek in Lake Erie. U.S. Dept. Interior, Office Water Resources and Technology Contract No. 14-34-001-9128, Project Completion Report, Ohio State University, Water Resources Center, Columbus, OH. 198pp.



Bernhart, G.E. 1985. The Terrestrial Vertebrates of the Old Woman Creek Watershed. Final report submitted to Sanctuary Programs Div. NOAA/NOS, and ODNR, Div. of Natural Areas and Preserves. 45pp.

Binion, B.M. 1995. Effects of Non-Point Nutrient Loading on Planktonic Community Structure and Function in a Great Lakes Coastal Wetland. M.Sc. Thesis, Morehead State University.

\_\_\_\_\_ and B.C. Reeder. 1996. Effects of Non-point Pollution on Algal Community Structure in Old Woman Creek wetland. Final report submitted to Old Woman Creek State Nature Preserve and National Estuarine Research Reserve.

Black, J.J. and P.C. Baumann. 1991. Carcinogens and cancers in freshwater fishes. *Environ. Health Perspectives* 90: 27-33.

Bonniwell, E.C. 2001. Evaluating Soil Erosion and Sediment Transport with Radionuclides. Ph.D. Thesis. Case Western Reserve University. 264pp.

Boutis, N.M. 1992. A Guide to the Amphibians and Reptiles of Old Woman Creek and Sheldon Marsh State Nature Preserves. Report to Ohio Dept. Natural Resources, Div. Natural Areas and Preserves, Columbus, OH. 8 pp.

Brant, R.A. and C.E. Herdendorf. 1972. Delineation of Great Lakes estuaries. *International Assoc. Great Lakes Research. Proc. 15<sup>th</sup> Conf. Great Lakes Research.* P. 710-718.

Brush, G.S. and L.M. Brush. 1997. Natural and Anthropogenic History of Three Freshwater Wetlands: A Paleoecological Study. Final report submitted to Sanctuary Programs Div.-NOAA/NOS, and ODNR, Div. of Natural Areas and Preserves. 122 pp. + appendices.

Buchanan, D.B. 1982. Transport and Deposition of Sediment in Old Woman Creek Estuary, Erie County, Ohio. M.Sc. Thesis, The Ohio State University. Reprinted as Ohio Sea Grant Technical Bulletin, OHSU-TB-10-83.

Bur, M.T. and D.M. Klarer. 1991. Prey selection for the exotic cladoceran *Bythotrephes cederstroemi* by selected Lake Erie fishes. *J. Great Lakes Res.* 17: 85-93.

\_\_\_\_\_ and K.A. Krieger. 1986. First records of a European cladoceran, *Bythotrephes cederstroemi*, in Lakes Erie and Huron. *J. Great Lakes Res.* 12(2):144-146.

Chin, Y.- P., E.J. Traina, and C.R. Swank. 1998. Abundance and properties of dissolved organic matter in pore water of a freshwater wetland. *Limnol. Oceanogr.* 43(6): 1287-1296.

Chow-Fraser, P. 2006. Development of the water quality index (WQI) to assess effects of basin-wide land-use alteration on coastal marshes of the Laurentian Great Lakes. In: Coastal Wetlands of the Laurentian Great Lakes: Health, Habitat, and Indicators.(Simon, T.P. and P.M. Stewart, eds) AuthorHouse Publishers, Bloomington, IN. pp.137-167.

Clarke, S.L. 1990. The Role of Organic Matter in the Formation of Authigenic Pyrite at Old Woman Creek Estuary, Erie County, Ohio. M.Sc. Thesis, Bowling Green State University.

Crites, J.L., J.D. Stamper, and C.E. Herdendorf. 1984. Parasites of Fishes of Old Woman Creek National Estuarine Sanctuary. Final report submitted to Sanctuary Programs Div.- NOAA/NOS, and ODNR, Division of Natural Areas and Preserves. 28 pp.

Danz, N.P., R.R. Regal, G.J. Niemi, V.J. Brady, T. Hollenhorst, L.B. Johnson, G.E. Host, J.M. Hanowski, C.A. Johnston, T. Brown, J.C. Kingston, J.R. Kelly. 2005. Environmentally stratified sampling design for the development of Great Lakes environmental indicators. Environ. Monit. Assess. 102: 41-65.

Degroft, K.L. and D.A. Francko. 1996. Effect of freezing on germination of *Nelumbo lutea* (Willd.) Pers. seeds. J. Freshwater Ecol. 11(3): 373-376.

Delorme, L.D. 1994. Freshwater Ostracoda from Old Woman Creek Wetlands, Ohio, USA. National Water Research Institute, Canada Centre for Inland Waters. Tech Service Report No. 94-0-246. Burlington, ON. 2pp.

Emmons, E.E. 1984. Feeding Ecology of White Bass (*Morone chrysops*) and White Perch (*Morone americana*) from Two Inshore Areas of Lake Erie. M.Sc. Thesis, Bowling Green State University.

Evans, J.E. and D.E. Seamon. 1997. A GIS model to calculate sediment yields from a small rural watershed, Old Woman Creek, Erie and Huron Counties, Ohio. Ohio J. Sci. 97(3): 44-52.

Everett, C.R., Y.-P. Chin, and G.R. Aiken. 1999. High-pressure size exclusion chromatography analysis of dissolved organic matter isolated by tangential-flow ultrafiltration. Limnol. Oceanogr. 44(5): 1316-1322.

Fahnenstiel, G.L., D. F. Millie, J. Dyble, R. W. Litaker, P. A. Tester, M. J. McCormick, R. Rediske, and D. Klarer. 2008. Microcystin Concentrations and cell quotas in Saginaw Bay, Lake Huron. Aquatic Ecosystem Health and Management 11(2):190-195.

Fahnenstiel, G, D.M. Klarer, D. Millie, M. McCormick, and A. Foley. 2005. Epilithic algae in the North Channel, Lake Huron. Verh. Internat. Verein. Limnol. 29: 823-826.

Fischer, L.D. 1983. A laterally averaged model of momentum and energy transport with application to seiche hydraulics. MSc. Thesis, Ohio State University.

Folmer, L.C., J. Harshbarger, P.C. Baumann, G. Gardner, and S. Bonomelli. 1995. Pathological and serum chemistry profiles of Brown Bullheads (*Ameiurus nebulosus*) from the Black River and Old Woman Creek, Ohio. Bull. Environ. Contam. Toxicol. 54: 50-59.

Fortner, R.W., et al. 1988. Evaluation of the Effectiveness of Some Components of the Education Program at Old Woman Creek (Ohio) National Estuarine Research Reserve. Final report submitted to Sanctuary Programs Div.- NOAA/NOS, and ODNR, DNAP. 47 pp. + appendices.

Francis, D.R., D.J. Jude, and J.A. Barres. 1998. Mercury distribution in the biota of a Great Lakes estuary: Old Woman Creek, Ohio. *J. Great Lakes Res.* 24(3): 595-607.

Francko, D.A. and R. Whyte. 1995a. A pilot study of littoral vegetation in the Old Woman Creek NERR: Community dynamics, energy flow, and sediment seed bank. Final Project Report, Ohio Dept. Natural Resources, Div. Of Natural Areas and Preserves. 26pp.

\_\_\_\_\_. 1995b. A Study of Littoral Vegetation in the Old Woman Creek NERR. Final report submitted to Sanctuary Programs Div.- NOAA/NOS, and ODNR, Div. of Natural Areas and Preserves. 20 pp. + appendices.

\_\_\_\_\_. 1997. Midsummer Photosynthetic Carbon Budget for Old Woman Creek Wetland, Ohio: Relative Contribution of Aquatic Macrophytes versus Phytoplankton. *Ohio J. Sci.* 99 (2): 6-9.

Frizado, J., R. Anderhalt, C. Mancuso, and L. Norman. 1986. Depositional and Diagenetic Processes in a Freshwater Estuary. Final report submitted to Sanctuary Programs Div. NOAA/NOS and ODNR, Div. of Natural Areas and Preserves. 226 pp.

Gaberell, M., Y.-P. Chin, S.J. Hug, and B. Sulzberger. 2003. Role of Dissolved Organic Matter Composition on the Photoreduction of Cr(VI) to Cr(III) in the Presence of Iron. *Environ. Sci. & Technol.*

Garono, R.J. and J.C. Kooser 1994. List of Caddisfly species collected at Kent Bog and Old Woman Creek Estuary. Ohio Dept. Natural Resources, Div. Natural Areas and Preserves, Old Woman Creek SNP manuscript report, Huron, OH. 2pp.

\_\_\_\_\_. 2001. The Relationship between Patterns in Flying Adult Insect Assemblages and Vegetation Structure in Wetlands of Ohio and Texas. *Ohio J. Sci.* 101(2): 12-21.

Gottgens, J.F. 2000. Wetland Restoration along the Southwestern Lake Erie Coast Line: Case Studies and Recommendations. *Toledo Journal of Great Lakes Legal Science and Policy* 3: 48-65.

Gregory, K.E. 1996. Spatial Aggregation, Parameterization, and Scale Dependence in Disturbed Nonpoint Source Pollution Modeling. Ph.D. Dissertation, Kent State University.

Harvill, M.L. 2000. Aquatic Insects of Old Woman Creek. Final report submitted to Lake Erie Protection Fund, Toledo, OH 32pp.

Havens, K. 1991a. An Analysis of Zooplankton Dynamics and Algal-Zooplankton Interactions in a Freshwater Estuary. Final report submitted to Sanctuary Programs Division, NOAA/NOS, and ODNR, Div. of Natural Areas and Preserves. 117 pp. + appendix.

\_\_\_\_\_ 1991b. Fish induced sediment resuspension: Effects on phytoplankton biomass and community structure in a shallow hypereutrophic lake. *J. Plankton Res.* 13: 1163-1176.

\_\_\_\_\_ 1991c. The importance of rotiferan and crustacean zooplankton as grazers of algal productivity in a freshwater estuary. *Arch. Hydrobiol.* 122: 1-22.

\_\_\_\_\_ 1991d. Zooplankton dynamics in a freshwater estuary. *Arch. Hydrobiol.* 123: 69-97.

\_\_\_\_\_ 1993. Responses to experimental fish manipulation in a shallow hypereutrophic lake: the relative importance of benthic nutrient recycling and trophic cascade. *Hydrobiologia* 254: 73-80.

Heath, R.T. 1986. Phosphorus Dynamics in the Old Woman Creek National Estuarine Sanctuary - A Preliminary Investigation. Final report submitted to Sanctuary Programs Div.-NOAA/NOS, and ODNR, Div. of Natural Areas and Preserves. 105 pp. Reprinted as NOAA Technical Memorandum, NOS MEMD 11. 1987.

\_\_\_\_\_. 1992a. Nutrient dynamics in Great Lakes coastal wetlands: Future directions. *J. Great Lakes Res.* 18: 590-602.

\_\_\_\_\_. 1992b. Phosphorus dynamics in Old Woman Creek National Estuarine Research Reserve. In: Proceedings: International Wetland Symposium Wetlands of the Great Lakes (J. Kusler and R. Smardon, eds.) Association of State Wetland Managers, Inc. pp: 122-129.

Herdendorf, C.E. 1963. The Geology of the Vermilion Quadrangle, Ohio. M.Sc. Thesis. Ohio University, Athens, OH 182pp+3 plates.

\_\_\_\_\_. 1974. Zoogeographic Description of Old Woman Creek Estuary, Ohio State University, Center for Lake Erie Area Research, Columbus, OH. 15pp.

\_\_\_\_\_. 1987. The ecology of the coastal marshes of western Lake Erie: A community profile. U.S. Fish and Wildlife Service Report 85(7.9). Washington, D.C. 240 pp.

\_\_\_\_\_. 1989. Paleogeography and geomorphology. In: Lake Erie Estuarine Systems: Issues, Resources, Status, and Management (K. Krieger, ed.) NOAA Estuary-of-the-Month Seminar Series No.14. pp: 353-70.

\_\_\_\_\_. 1990. Great Lakes Estuaries. *Estuaries* 13: 493-503.

\_\_\_\_\_. 2004. Morphometric factors in the formation of Great Lakes coastal wetlands. *Aquat. Ecosystem Health & Management* 7(2): in press.

\_\_\_\_\_, R.C. Herdendorf, and D.M. Klarer. 1999 (revised 2001). Catalogue of the vascular plants in Old Woman Creek estuary and watershed. Old Woman Creek State Nature Preserve and National Estuarine Research Reserve Tech Report No. 10. Site Profile Contribution No.1. ODNR, Div. of Natural Areas and Preserves. 112 pp.

\_\_\_\_\_. 1999 (revised 2001). Catalogue of the vertebrate fauna of Old Woman Creek estuary, watershed, and environs. Old Woman Creek State Nature Preserve and National Estuarine Research Reserve Tech Report No. 11. Site Profile Contribution No.2. ODNR, Div. of Natural Areas and Preserves. 73 pp.

\_\_\_\_\_. 2000 (revised 2001). Catalogue of the Invertebrate Fauna in Old Woman Creek Estuary, Watershed, and Adjacent Waters of Lake Erie. Old Woman Creek Tech. Report No. 12 (Site Profile Contribution No. 3) Ohio Department of Natural Resources, Division of Natural Areas and Preserves. 130 pp.

\_\_\_\_\_. 2000 (revised 2001). Bibliography of Research Publications for Old Woman Creek Estuary, Watershed, and Adjacent Waters of Lake Erie. Old Woman Creek Tech. Report No. 14 (Site Profile Contribution No. 5) Ohio Department of Natural Resources, Division of Natural Areas and Preserves. 74pp.

\_\_\_\_\_ and T.M. Hume. 1991. Morphometry and water storage in Old Woman Creek: a freshwater estuary in western Lake Erie. OWC Tech. Report #7, ODNR, Division of Natural Areas and Preserves. 22 pp. + 5 app.

\_\_\_\_\_, D.M. Klarer, and R.C. Herdendorf. 2004. The Ecology of Old Woman Creek, Ohio: An Estuarine and Watershed Profile. Ohio Department of Natural Resources, Division of Natural Areas and Preserves, Columbus, Ohio. 448 pp.

\_\_\_\_\_ and K.A. Krieger. 1989. Overview of Lake Erie and its estuaries within the Great Lakes ecosystem. In: Lake Erie Estuarine Systems: Issues, Resources, Status, and Management (K. Krieger, ed.) NOAA Estuary-of-the-Month Seminar Series No.14. pp: 1-34.

\_\_\_\_\_ and A. M. Wilson (eds). Limnological Survey of Old Woman Creek Estuary, Lake Erie. Ohio State University, F.T. Stone Laboratory Research Report No.6 Put-in-Bay, OH 81pp.

Hoffman, W.S. 1985. The Fishes of Old Woman Creek Estuary. OWC Technical Report #4, ODNR, Div. of Natural Areas & Preserves. 24 pp. + 1 app.

Holly, B.P. 1986. Demographic, Land Use, and Environmental Forecasts for the Old Woman Creek National Estuarine Sanctuary, 1985-2005. Final report submitted to Sanctuary Programs Div.-NOAA/NOS, and ODNR, Div. of Natural Areas and Preserves. 79 pp.

Ingold, J.L., N.D. Mundahl, and S.I. Guttman. 1984. Ecology and population genetics of the freshwater bryozoan, *Pectinatella magnifica* Leidy. J. Freshwater Ecol. 2: 499-508.

Jensen, S. 1992. Environmental components influencing epipelagic algal community structure. Ph.D. Thesis, Bowling Green State University.

Johnson, D.L. 1989. Lake Erie wetlands: Fisheries considerations. In: Lake Erie Estuarine Systems: Issues, Resources, Status, and Management (K. Krieger, ed.) NOAA Estuary-of-the-Month Seminar Series No.14. pp: 257-273.

Johnson, N.J. and K.A. Krieger. 2004. Atlas of the Chironomid Midges (Class Insecta: Order Diptera; Family Chironomidae) recorded at the Old Woman Creek National Estuarine Research Reserve and State Nature Preserve, Ohio. (Report submitted to Ohio Department of Natural Resources, to be published as Old Woman Creek Technical Report No.16) 25 pp.

Johnston, E.P. and P.C.Baumann. 1989. Analysis of fish bile with HPLC-fluorescence to determine environmental exposure to benzo(a)pyrene. In Environmental Bioassay Techniques and their Application (Munawar,M., G.Dixon, C.I.Mayfield, T.Reynoldson, and M.H.Sadar, eds.) Hydrobiologia 188/189: 561-566.

Jude, D.J., D. Francis, R. Rossmann, and J. Barres. 1992. Mercury partitioning in a Great Lakes estuary: Old Woman Creek Ohio. Final report submitted to Sanctuary Programs Div.-NOAA/NOS and ODNR, Div. of Natural Areas and Preserves. 23 pp.

\_\_\_\_\_ and J. Pappas. 1992. Fish utilization of Great Lakes coastal wetlands. J. Great Lakes Res. 18(4): 651-672.

Kepner, R., Jr. and J.R. Pratt. 1993. Characterization of benthic organic matter and surface-associated microbial communities at the Old Woman Creek national Estuarine Research Reserve. Final report submitted to Sanctuaries and Reserves Div.-NOAA/NOS and ODNR, Div. of Natural Areas and Preserves. 45 pp. and appendices.

\_\_\_\_\_. 1996. Characterization of surface-associated protozoan communities in a Lake Erie coastal wetland (Old Woman Creek, Ohio). J. Great Lakes Res. 22(1): 63-76.

Ketterer, M.E., B.R. Watson, G. Matisoff, and C.G. Wilson. 2002. Rapid Dating of recent aquatic sediments using Pu activities and  $^{240}\text{Pu}/^{239}\text{Pu}$  as determined by quadrupole inductively coupled plasma mass spectrometry. Environ. Sci. Technol. 36(6):1307-1311.

Klarer, D.M. 1981. Limnological Study of Old Woman Creek National Estuarine Sanctuary for Collection of Baseline Data. Final report C.E.I.P. Program Contract Number 80-103, and ODNR, Div. of Natural Areas and Preserves. 60 pp. (OWC Tech. Report #2, ODNR, Div. of Natural Areas & Preserves)

\_\_\_\_\_.1985. An Annotated Species List of the Algae of Old Woman Creek Estuary. OWC Tech. Report #3, ODNR, Div. of Natural Areas and Preserves. 48 pp.

\_\_\_\_\_. 1988. The Role of a Freshwater Estuary in Mitigating Storm-Water Inflow. OWC Tech. Report #5, ODNR, Div. of Natural Areas and Preserves. 54 pp. + 1 app.

\_\_\_\_\_. 1989. Plankton and macroinvertebrates. In: Lake Erie Estuarine Systems: Issues, Resources, Status, and Management (K. Krieger, ed.) NOAA Estuary-of-the-Month Seminar Series No.14. pp: 177-189.

\_\_\_\_\_, C.E. Herdendorf, and R.C. Herdendorf 2000 (revised 2001). Catalogue of the Algal Flora and the Lower Plants in Old Woman Creek Estuary, Watershed, and Adjacent Waters of Lake Erie. Old Woman Creek Tech. Report No. 13 (Site Profile Contribution No. 4) Ohio Department of Natural Resources, Division of Natural Areas and Preserves. 133 pp.

\_\_\_\_\_, K.A. Krieger, R.T. Heath, and C.E. Herdendorf. 1992. Priorities for Great Lakes Coastal Wetlands Research: Recommendations of a planning conference. In: Proceedings: International Wetland Symposium Wetlands of the Great Lakes (J. Kusler and R. Smardon, eds.) Association of State Wetland Managers, Inc. pp: 301-303.

\_\_\_\_\_, and D.F. Millie. 1989. Amelioration of storm-water quality by a freshwater estuary. Arch. Hydrobiol. 116: 375-389.

\_\_\_\_\_. 1992. Aquatic macrophytes and algae at Old Woman Creek Estuary and other Great Lakes coastal wetlands. J. Great Lakes Res. 18: 622-633.

\_\_\_\_\_. 1994. Regulation of phytoplankton dynamics in a Laurentian Great Lakes estuary. Hydrobiologia 286: 97-108.

Klupinski, T.P., Y.-P. Chin, and S. J. Traina. 2004. Abiotic degradation of Pentachloronitrobenzene by Fe(II): Reactions on goethite and iron oxide nanoparticles. Environ. Sci. Technol. 38: 4353-4360.

Kooser, J.G., R.J. Garono, and B.L. Kooser. 1997. Fine scale plant community structure and composition in Ohio and Texas wetlands. Ohio J. Sci. 97(2): 27.

Krieger, K.A. 1984. Transport and Assimilation of Nutrients and Pesticides in a Lake Erie Estuary. Final report submitted to Sanctuary Programs Div.- NOAA/NOS, and ODNR, Div. of Natural Areas and Preserves. 29 pp.

\_\_\_\_\_. 1985. A Comparative Study of Crustacean Zooplankton Community Structure and Dynamics in a Lake Erie Marsh and the Adjacent Wave Zone. Final report submitted to Sanctuary Programs Div.- NOAA/NOS, and ODNR, Div. of Natural Areas and Preserves. 49 pp.

\_\_\_\_\_. 1989. Chemical limnology and contaminants. In: Lake Erie Estuarine Systems: Issues, Resources, Status, and Management (K. Krieger, ed.) NOAA Estuary-of-the-Month Seminar Series No.14. pp: 149-175.

\_\_\_\_\_. 1992. The ecology of invertebrates in Great Lakes coastal wetlands: Current knowledge and research needs. J. Great Lakes Res. 18: 634-650.

\_\_\_\_\_. 1993. A Method for Estimating Fluxes from Coastal Wetlands into the Great Lakes, with an Example from Lake Erie. Ohio Sea Grant Technical Bulletin OHSU-TB-025-93. 27pp.

\_\_\_\_\_. 2001. Effectiveness of a Coastal Wetland in Reducing the Movement of Agricultural Pollutants into Lake Erie. Final Report submitted to Old Woman Creek NERR and Ohio Sea Grant. Old Woman Creek Tech. Report No. 15. Ohio Department of Natural Resources, Division of Natural Areas and Preserves. 247pp.

\_\_\_\_\_. 2003. Effectiveness of a coastal wetland in reducing pollution of a Laurentian Great Lake: Hydrology, sediment, and nutrients. *Wetlands* 23: 778-791.

\_\_\_\_\_ and D.M. Klarer. 1991. Zooplankton dynamics in a Great Lakes coastal marsh. *J. Great Lakes Res.* 17: 255-269.

\_\_\_\_\_. 1992. Macroinvertebrate Communities of the Old Woman Creek National Estuarine Research Reserve. Final report submitted to the Sanctuaries and Reserves Div.-NOAA/NOS, and ODNR, Div. of Natural Areas and Preserves. 55 pp. and appendices. OWC Tech Report #9, ODNR, Div. of Natural Areas and Preserves.

\_\_\_\_\_. 1995. Spatial and Seasonal Distributions of Nonplanktonic Aquatic Invertebrates in the Old Woman Creek National Estuarine Research Reserve. Final report submitted to Sanctuaries and Reserves Div.-NOAA/NOS, and ODNR, Div. of Natural Areas and Preserves. 47 pp. and appendices.

\_\_\_\_\_, R.T. Heath, and C.E. Herdendorf. 1990. Priorities for Great Lakes Coastal Wetlands Research. Proceedings of a Conference held at Old Woman Creek National Estuarine Research Reserve, Huron, Ohio, 20-21 October 1989. OWC Tech Report #6, ODNR, Div. of Natural Areas and Preserves.

\_\_\_\_\_. 1992. A call for research on Great Lakes coastal wetlands. *J. Great Lakes Res.* 18: 525-528.

Kroll, J. 2006. Land use and soil organic carbon variability in the Old Woman Creek watershed of North Central Ohio. MA thesis, Miami University. 132pp.

Kulesza, A.E. 2005. Effects of Phragmites spread and removal by Glyphosate application on benthic macroinvertebrate diversity in Old Woman Creek freshwater estuary. M.Sc. Thesis, The Ohio State University. 49 pp.

Kulesza, A.E. and J.R. Holomuzki. 2006. Amphipod performance responses to decaying leaf litter of *Phragmites australis* and *Typha angustifolia* from a Lake Erie coastal marsh. *Wetlands* 26: 1079-1088.

\_\_\_\_\_, and D.M. Klarer. 2008. Benthic community structure in stands of *Typha angustifolia* and herbicide-treated and untreated- *Phragmites australis*. *Wetlands* 28: 40-56.

Lahm, A.C. 1986. An Evaluation of the School and Field Components of the Outreach Program of Old Woman Creek National Estuarine Sanctuary. M.Sc. Thesis, The Ohio State University.



Lavrentyev, P.J. 2004 A preliminary guide to common planktonic protists and micrometazoa of the Old Woman Creek State Nature Preserve. Report submitted to Ohio Department of Natural Resources, to be published as Old Woman Creek Technical Report No.17.) 64pp.

\_\_\_\_\_, W.S. Gardner, and J.R. Johnson. 1997. Cascading trophic effects on aquatic nitrification: experimental evidence and potential implications. *Aquat. Microb. Ecol.* 13: 161-175.

\_\_\_\_\_, D.M. Klarer, and W.S. Gardner. 1998. The Microbial Community Structure and Nitrogen Dynamics in a Lake Erie Coastal Wetland, Old Woman Creek. Final report submitted to the Ohio Lake Erie Protection Fund and the ODNR, Div. Natural Areas and Preserves. 15pp.

\_\_\_\_\_, M.J. McCarthy, D.M. Klarer, F. Jochem, and W.S. Gardner. 2004. Microbial food web and nitrogen dynamics in a storm-driven Lake Erie wetland. *Microb. Ecol.* 48: 567-577.

Li, R., T. Ali, R. Ma, and K. Di. 2001. Modeling Nutrient-Enriched Sediments Transport During Coastal Erosion Processes. Final report submitted to Ohio Lake Erie Protection Fund. 81 pp.

Light, R.1992. Modeling heavy metal removal in wetlands. M.Sc. Thesis, The University of Virginia.

Lynn, S.G. 2006. Cloning and expression of key endocrine genes in a study of estrogen stimulated sexual size dimorphism (SSD) in Yellow Perch. Ph.D. Dissertation. The University of Kentucky.

\_\_\_\_\_ and B.S. Shepherd. 2007. Molecular characterization and sex-specific tissue expression of prolactin, somatolactin and insulin-like growth factor-1 in yellow perch (*Perca flavescens*). *Comp. Biochem. and Physiol. B* 147(3): 412-427.

\_\_\_\_\_, W.J. Birge, and B.S. Shepherd. 2008. Molecular characterization and sex-specific tissue expression of estrogen receptor  $\alpha$  (esr1), estrogen receptor  $\beta$ a (esr 2a) and ovarian aromatase (cyp19a1a) in yellow perch (*Perca flavescens*). *Comp. Biochem. and Physiol. B* 149(1): 126-147.

Mack, J.J., N.H. Advis, E.C. Braig IV, D.L. Johnson. 2008. Application of a vegetation-based index of biotic integrity for Lake Erie coastal marshes in Ohio. *Aq. Ecosys. Health and Mgt.* 11(1): 91-104.

Mancuso, C.M. 1986. Distribution of Trace Elements in the Interstitial Waters and Sediments of a Freshwater Estuary. M.Sc. Thesis, Bowling Green State University.

Marshall, J.M. 1977. Floristic Analysis of the Vascular Plants of the Old Woman Creek Estuary and Contiguous Uplands, Erie County, Ohio. M.Sc. Thesis, The Ohio State University (CLEAR Tech. Rept, #67.)

Marshall, J.M. and R.L. Stuckey. 1974. Aquatic Vascular Plants and their Distribution in the Old Woman Creek Estuary, Erie County, Ohio. Final report submitted to ODNR, Div. Research

Martz, T. and D.A. Francko. 1998. Primary Productivity at the Old Woman Creek National Estuarine Research Reserve, Huron, Ohio. Final Report submitted to Sanctuaries and Reserves Program, NOAA/NOS, and ODNR, Div Natural Areas and Preserves. 12 pp.

Matisoff, G., E.C. Bonniwell, and P. J. Whiting. 2002. Soil Erosion and Sediment Sources in an Ohio Watershed using Beryllium-7, Cesium-137, and Lead-210. *J. Environmental Quality* 31: 54-61.

\_\_\_\_\_. 2002. Radionuclides as Indicators of Sediment Transport in Agricultural Watersheds that Drain to Lake Erie. *J. Environmental Quality* 31: 62-72.

\_\_\_\_\_ and J.P. Eaker. 1989. Groundwater Advection and Sediment-Water Chemical Exchange at Old Woman Creek Freshwater Estuary. Final report submitted to Sanctuary Programs Division, NOAA/NOS, and ODNR, Div. Natural Areas and Preserves. 157 pp.

\_\_\_\_\_. 1992. Summary of Sediment Chemistry Research at Old Woman Creek, Ohio. *J. Great Lakes Res.* 18: 603-621.

\_\_\_\_\_, P.J. Whiting, and E.C. Bonniwell. 1998. Evaluation of Watershed Management Programs by Tracing Sediment and Associated Contaminants: A One-Year Study at Old Woman Creek. Final Report submitted to Sanctuaries and Reserves Program, NOAA/NOS, and ODNR, Div. Natural Areas and Preserves. 49 pp. and appendices

McCarthy, M.J., P.J. Lavrentyev, K.M. Moats, F.J. Jochem, and D.M. Klarer. 2007. Effects of hydrological flow regime on sediment-water interface and water column nitrogen dynamics in a Great Lakes coastal wetland (Old Woman Creek, Lake Erie). *J. Great Lakes Res.* 33(1): 219-231.

Micucci, S.M. and D.J. Stouder. 2000. Estuarine Function with Emphasis on Fishes in a Marine and a Freshwater Estuary. Final Report submitted to Estuarine Research Division, NOAA, and ODNR, Div. Natural Areas and Preserves. 98pp. (originally submitted by S.M. Micucci as M.Sc. Thesis, Ohio State University)

Millie, D.F., G.L. Fahnenstiel, J. Dyble, R. Pigg, R. Rediske, D.M. Klarer, R.W. Litaker, P.A. Tester. 2008. Influence of environmental conditions on late-summer Cyanobacterial abundance in Saginaw Bay, Lake Huron. *Aquatic Ecosystem Health and Management* 11(2): 196-205.

Miller, M.W. 1982. A Survey of the Order Trichoptera occurring within the Old Woman Creek watershed. Final Report submitted to OWC SNP and NERR. 28pp.

Miller, M.W., A. Huryn, and D.M. Klarer. 1984. Two new Ohio records of Trichoptera: *Rhyacophila ledra* Ross and *Phraganea cinerea* Walker. *Ohio J. Sci.* 84(3): 141-142.

Miller, P.L. and Y.-P. Chin. 2002. Photoinduced degradation of carbaryl in a wetland surface water. *J. Agric. Food Chem.* 50: 6758-6765.

\_\_\_\_\_. 2005. Indirect photolysis promoted by natural and engineered wetland water Constituents: Processes leading to Alachlor Degradation. *Environ. Sci. Tech.* 39(12): 4454-4462.

Millie, D.F. and D.M. Klarer. 1980. Survey of Epiphytic Diatoms Along the Ohio Coast of Lake Erie. Final report submitted to the ODNR - Ohio Coastal Zone Management Program. 45 pp. (OWC Tech Report #1, ODNR, Div. of Natural Areas & Preserves)

Millie, D.F., G.L. Fahnenstiel, J. Dyble, R. Pigg, R. Rediske, D.M. Klarer, R.W. Litaker, P.A. Tester. 2008. Influence of environmental conditions on late-summer Cyanobacterial abundance in Saginaw Bay, Lake Huron.

Millie, D.F., G.L. Fahnenstiel, J. Dyble, R.J. Pigg, R.R. Rediske, D.M. Klarer, P.A. Tester, and R.W. Litaker. Bloo-forming phytoplankton in western Lake Erie during late summer: distribution, environmental influences, and implications of cyanobacterial toxicity. *J. Phycol.*

Mitsch, W.J.(ed.). 1989. Wetlands of Ohio's Coastal Lake Erie: A Hierarchy of Systems. Ohio State University, Ohio Sea Grant Program. Columbus. 186 pp.

Mitsch, W.J. 1989. Wetlands of Ohio's Coastal Lake Erie- a hierarchy of systems. 1989. In: Wetlands of Ohio's Coastal Lake Erie: A Hierarchy of Systems. (W.J. Mitsch, ed.) Ohio State University, Ohio Sea Grant Program. Columbus. pp. 1-16.

\_\_\_\_\_. 1992. Combining ecosystem and landscape approaches to Great Lakes wetlands. *J. Great Lakes Res.* 18: 552-570.

\_\_\_\_\_. 1992. Ecological indicators for ecological engineering in wetlands. In Ecological Indicators (D. McKenzie, et al., eds.) Elsevier, Amsterdam. pp: 535-556.

\_\_\_\_\_. 1992. Wetlands, ecological engineering, and self-design. *Great Lakes Wetlands* 3(1):1-3,7.

\_\_\_\_\_. 1992. Applications of ecotechnology to the creation and rehabilitation of temperate wetlands. In: Ecosystem Rehabilitation, Volume 2: Ecosystem Analysis, and Synthesis ( M. Wali, ed.) SPB Academic Publishing, The Hague. pp: 309-331.

\_\_\_\_\_. 1994. A comparison of the nonpoint source pollution control functions of natural and constructed riparian wetlands. In: Global Wetlands: Old World and New (W.J. Mitsch, ed.) Elsevier, Amsterdam. pp: 351-361.

\_\_\_\_\_, G. McNelly, and D.M. Robb. 1989. Physical and chemical characteristics of Lake Erie coastal wetland sediments. In: Wetlands of Ohio's Coastal Lake Erie: A Hierarchy of Systems. (W.J. Mitsch, ed.) Ohio Sea Grant Program. Columbus. pp: 135-143.

\_\_\_\_\_, R.H. Mitsch, and R.E. Turner. 1994. Wetlands of the Old and New Worlds - ecology and management. In: Global Wetlands: Old World and New (W.J. Mitsch, ed.) Elsevier, Amsterdam. pp: 3-56.

\_\_\_\_\_ and B.C. Reeder. 1989a. Diurnal patterns of dissolved oxygen in a freshwater coastal wetland. In: Wetlands of Ohio's Coastal Lake Erie: A Hierarchy of Systems. (W.J. Mitsch, ed.) Ohio Sea Grant Program. Columbus. pp: 19-47.

\_\_\_\_\_. 1989b. Ecosystem modeling of a Lake Erie coastal wetland. In: Wetlands of Ohio's Coastal Lake Erie: A Hierarchy of Systems. (W.J. Mitsch, ed.) Ohio Sea Grant Program. Columbus. pp: 161-174.

\_\_\_\_\_. 1991. Modeling nutrient retention of a freshwater coastal wetland: estimating the roles of primary productivity, sedimentation, resuspension and hydrology. *Ecol. Model.* 54: 151-187.

\_\_\_\_\_. 1992. Nutrient and hydrologic budgets of a Great Lakes coastal freshwater wetland during a drought year. *Wetlands Ecol. and Mgt.* 1: 211-223.

\_\_\_\_\_, and C. Carlson. 1989. Hydrology of a freshwater coastal wetland during severe drought conditions. In: Wetlands of Ohio's Coastal Lake Erie: A Hierarchy of Systems. (W.J. Mitsch, ed.) Ohio Sea Grant Program. Columbus. pp: 69-79.

\_\_\_\_\_, and D.M. Klarer. 1989. The role of wetlands for the control of nutrients with a case study of Western Lake Erie. In: Ecological Engineering: An Introduction to Ecotechnology (W.J. Mitsch and S.E. Jorgensen, eds.). John Wiley, New York. pp: 129-158.

\_\_\_\_\_, and D.M. Robb. 1994. Modeling ecosystem and landscape scales of Lake Erie coastal wetlands. In: Global Wetlands: Old World and New (W.J. Mitsch, ed.) Elsevier, Amsterdam. pp: 563-574.

Moats, K. 2006. M.Sc. Thesis, Akron University

Ohio Division of Wildlife. 1980. Old Woman Creek fish surveys 1970-1980. Ohio Dept Natural Resources, Div. Wildlife data reports, Columbus, OH

Olson, E.C. 1983. Nonformal Environmental Education in Natural Resources Management: A Case Study in the Use of Interpretation as a Management Tool for a State Nature Preserve System. Ph.D. Thesis, The Ohio State University.

Owen, B., F.L. Snyder, and R. Deehr. 1983. Comparative Food Habits of Young White Perch (*Morone americana* (Gmelin)) and White Bass (*Morone chrysops* (Rafinesque)) in Old Woman Creek Estuary. Report submitted to ODNR, Div. of Natural Areas and Preserves. 19 pp.

Patrick, J. 1982. Species Composition and Habitat Preference of Small Mammals in a Prairie-Forest Community in Northwest Ohio. Report submitted to Old Woman Creek SNP and NERR.

Perry, T.E. and J.E.K. Perry. 1983. Preliminary annotated list, adult Odonata of the Old Woman Creek estuary and Sheldon marsh Area. Ohio Dept. Natural Resources, Div. Natural Areas and Preserves, Huron, OH. Manuscript report. 2pp.

Pfister, R.M. and J.I. Frea. 1989. Relationship of Toxic Metals and Bacteria in Sediments of Old Woman Creek Estuary. Final report submitted to Sanctuary Programs Division, NOAA/NOS, and ODNR, Div. of Natural Areas and Preserves. 59 pp.

Pless, M. 1987. Evaluation of the Educational Effectiveness of Interpretive Exhibits for Adult Visitors to the Old Woman Creek National Estuarine Research Reserve and State Nature Preserve. M.Sc. Thesis, The Ohio State University.

Primack, A.G.B. and B. Governanti. 2004. Impervious surfaces change in Old Woman Creek watershed between the 1980's and 2003. Final report submitted to Old Woman Creek, Ohio Department of Natural Resources.

Reavie, E.D., R.P. Axler, G.V. Sgro, N.P. Danz, J.C. Kingston, A.R. Kireta, T.N. Brown, T.P. Hollenhorst, and M.J. Ferguson. 2006. Diatom-based weighted-averaging transfer functions for Great Lakes coastal water quality: relationships to watershed characteristics. *J. Great Lakes Res.* 32: 321-347.

Reed, S. 1999. Variatons in Epiphytic Diatom Populations of *Nelumbo lutea* at Old Woman Creek Undergraduate Honors Project (Dr. Susan Carty, advisor), Water Resources 393 Heidelberg College 29pp

Reeder, B.C. 1989. Quaternary history of Old Woman Creek wetland. In: Wetlands of Ohio's Coastal Lake Erie: A Hierarchy of Systems. (W.J. Mitsch, ed.) Ohio Sea Grant Program. Columbus. pp:97-109.

\_\_\_\_\_. 1990. Primary Productivity, Phosphate Cycling, and Sedimentation in a Lake Erie Coastal Wetland. Ph.D. Thesis. The Ohio State University.

\_\_\_\_\_. 1994. Estimating the role of autotrophs in nonpoint source phosphorus retention in a Laurentian Great Lakes coastal wetland. *Ecol. Eng.* 3: 161-169.

\_\_\_\_\_ and Binion, B.M. 2001. Comparison of methods to assess water column primary production in wetlands. *Ecol. Eng.* 17: 445-449.

\_\_\_\_\_ and W.R. Eisner. 1994. Holocene biogeochemical and pollen history of a Lake Erie, Ohio coastal wetland. *Ohio J. Sci.* 94(4): 87-93.

\_\_\_\_\_ and W.J. Mitsch. 1989. Seasonal patterns of planktonic and macrophyte productivity of a freshwater coastal wetland. In: Wetlands of Ohio's Coastal Lake Erie: A Hierarchy of Systems. (W.J. Mitsch, ed.) Ohio Sea Grant Program. Columbus. pp: 49-68.

\_\_\_\_\_. 1989. Bioavailable phosphorus and a phosphorus budget of a freshwater coastal wetland. In: Wetlands of Ohio's Coastal Lake Erie: A Hierarchy of Systems. (W.J. Mitsch, ed.) Ohio Sea Grant Program. Columbus. pp: 81-95.

\_\_\_\_\_. 1990. What is a Great Lakes Coastal Wetland Worth? A Bibliography. Ohio Sea Grant College Program Technical Series Report OHSU-TS-007. Columbus. 18 pp.

Robb, D.M. 1989. Diked and Undiked Wetlands of Coastal Lake Erie. M.Sc. Thesis. The Ohio State University.

\_\_\_\_\_ and W.J. Mitsch. 1989. Hydroperiod and water chemistry of diked and undiked wetlands in western Lake Erie. In: Wetlands of Ohio's Coastal Lake Erie: A Hierarchy of Systems. (W.J. Mitsch, ed.) Ohio Sea Grant Program. Columbus. pp: 113-133.

\_\_\_\_\_. 1992. Selected chemical parameters of diked and undiked Lake Erie marshes. In: Proceedings: International Wetland Symposium Wetlands of the Great Lakes (J. Kusler and R. Smardon, eds.) Association of State Wetland Managers, Inc. pp: 130-136.

Rotenberry, J.T., E.E. Emmons, and C.H. Hardman. 1987. Use of Backwater Marsh Areas by Fish Populations in Old Woman Creek and Surrounding Lake Erie Prior to Highway Construction. Final report submitted to Sanctuary Programs Div.- NOAA/NOS, and ODNR, Div. of Natural Areas and Preserves. 16 pp.

\_\_\_\_\_, T.M. Bergin, and B.S. Steiner. 1989. The Influence of Highway Construction on the Use of Backwater Marsh Areas by Fish Populations in Old Woman Creek and Surrounding Lake Erie. Final report submitted to Sanctuary Programs Division, NOAA/NOS, and ODNR, Div. of Natural Areas and Preserves. 23 pp. and appendices.

Roush, M.J., D.M. Robb, G.-C. Yi, and W.J. Mitsch. 1989. Remote sensing of Ohio's wetlands of western Lake Erie. In: Wetlands of Ohio's Coastal Lake Erie: A Hierarchy of Systems. (W.J. Mitsch, ed.) Ohio Sea Grant Program. Columbus. pp. 145-157.

Seamon, D.E. 1994. A Model for Soil Erosion Rates and Sediment Yields that Utilizes Geographic Information Systems, from Old Woman Creek Watershed, North-Central Ohio. M.Sc. Thesis. Bowling Green State University.

Sgro, G.V. 1998. Ecology and Assessment of the Algal Communities of Four Lake Erie Estuaries. PhD. Dissertation Cleveland State University.

Sgro, G.V. and J.R. Johansen. 1995. Ecology and Assessment of the Algae of Four Lake Erie Estuaries. Final Report submitted to the Lake Erie Protection Fund, Ohio Lake Erie Office. 62pp. and appendices.

\_\_\_\_\_, M.E. Ketterer, and J.R. Johansen. 2006. Ecology and assessment of the benthic diatom communities of four Lake Erie estuaries using Lange-Bertalot tolerance values. *Hydrobiologia* **561** *Advances in Algal Biology: A commemoration of the Work of Rex Lowe* (Stevenson, R.J., Y.Pan, J.P. Kociolek, and J.C. Kingston, eds.): 239-249.

\_\_\_\_\_, E.D. Reavie, J.C. Kingston, A.R. Kireta, M.J. Ferguson, N.P. Danz, and J.R. Johansen. 2007. A diatom quality index from a diatom-based total phosphorus inference model. *Environ. Bioindicators* **2**: 15-34.

Shane. O.C. III. 1981. Revised Preliminary Final Report of Mitigation of Three Prehistoric Indian Village Sites within the Right-of-way of Proposed Ohio State Route 2, Erie County, Ohio. Project No. RF-1115(5)ERI-2-18.38. Ohio Dept. Transportation, Columbus, OH. 77pp.

Simon, T.P., R.F. Thoma, and P.M. Stewart. 2006. Validation of an index of biotic integrity for fish assemblages in drowned river mouth wetlands of Lake Erie. In: *Coastal Wetlands of the Laurentian Great Lakes: Health, Habitat, and Indicators*.(Simon, T.P. and P.M. Stewart, eds.) AuthorHouse Publishers, Bloomington, IN. pp. 461-473.

Stewart, P.M., M.M. Pilarczyk, R.F. Thoma, and T.P. Simon. 2006. Development of a preliminary D-net macroinvertebrate index of biotic integrity for Lake Erie drowned river mouth coastal wetlands. In: *Coastal Wetlands of the Laurentian Great Lakes: Health, Habitat, and Indicators*.(Simon, T.P. and P.M. Stewart, eds) AuthorHouse Publishers, Bloomington, IN. pp. 363-374.

Stuckey, R/L/ 1989. Western Lake Erie aquatic and wetland vascular plant-flora: its origin and change. In: *Lake Erie Estuarine Systems: Issues, Resources, Status, and Management* (K. Krieger, ed.) NOAA Estuary-of-the-Month Seminar Series No.14. pp: 205-256.

Thibault, R.E. 1984. Fish Recruitment and Secondary Production in Two Lake Erie Environments: Old Woman Creek Estuary and Sheldon's Marsh. Final report submitted to Sanctuary Programs Div.- NOAA/NOS, and ODNR, Div. of Natural Areas and Preserves. 35 pp.

\_\_\_\_\_. 1985. Fish Recruitment and Secondary Production in Old Woman Creek Estuary, Huron, Ohio. Final report submitted to Sanctuary Programs Div.- NOAA/NOS, and ODNR, Div. of Natural Areas and Preserves. 19 pp. and supplement.

Tomaszek, J.A., W.S. Gardner, and T.H. Johengen. 1997. Denitrification in sediments of a Lake Erie coast wetland (Old Woman Creek, Huron, Ohio). *J. Great Lakes Res.* **23**(4): 403-415.

Trexel-Kroll, D. 2002. Succession of Floating-Leaf to Emergent Plant Communities Following Reduced Water Levels in Old Woman Creek National Estuarine Research Reserve, Huron, Ohio. M.Sc. Thesis, Miami University, Oxford, OH 32 pp and tables and figures.

Van Evra, R.E. III. 1983. Coastal Data Acquisition and Retrieval Tower (CDART). M.Sc. Thesis, The Ohio State University.

Vance, H.D. and D.A. Francko. 1997. Allelopathic potential of *Nelumbo lutea* (Willd.) Pers. to alter growth of *Myriophyllum spicatum* L. and *Potamogeton pectinatus* L. J. Freshwater Ecol. 12 (3): 405-409.

Whyte, R.S. 1996. The Vegetation Dynamics of a Freshwater Estuary on Lake Erie. Ph.D. Thesis, Miami University (Ohio).

\_\_\_\_\_. 2005. A Floristic Survey of the Old Woman Creek Estuary. Final Report of the SWMP Biomonitoring Grant submitted to NOAA, Estuarine Reserves Division and Ohio DNR, Division of Wildlife. 18pp & Figures.

Whyte, R.S. and D.A. Francko. 2001. Dynamics of a pioneer population of Eurasian Watermilfoil (*Myriophyllum spicatum* L.) in a shallow Lake Erie wetland. J. Aquat. Plant Manage. 39: 136-139.

Whyte, R.S., D.A. Francko, and D.M. Klarer. 1997. Distribution of the floating-leaf macrophyte *Nelumbo lutea* (American Water Lotus) in a coastal wetland on Lake Erie. Wetlands 17(4): 567-573.

\_\_\_\_\_. 2003. Aquatic Vegetation of Old Woman Creek National Estuarine Research Reserve (Huron, OH): A Lake Erie coastal wetland. Michigan Bot. 42: 63-84.

Whyte, R.S., J. Holomuzki, and D.M. Klarer. 2009.

Whyte, R.S., D. Trexell-Kroll, R. Shields, D.M. Klarer, and D.A. Francko. 2008. The invasion and spread of *Phragmites australis* during a period of low water in a Lake Erie coastal wetland. J. Coastal Research SI 55: 111-120.

Wickstrom, C.E. 1988. Assimilation and Release of Dinitrogen within Old Woman Creek Estuary - Nitrogenase Activity and Dissolved Inorganic Nitrogen. Final report submitted to Sanctuary Programs Div. NOAA/NOS, and ODNR, Div. of Natural Areas and Preserves. 109 pp.

\_\_\_\_\_, and J.L. Corkran. 1997. Nitrogenase activities associated with macrophytes from a lacustrine and a freshwater estuarine habitat. Aquat. Bot. 59:157-162.

Wilson, C. 2003. Determining Fine Sediment Sources from the Three National Estuarine Research Reserve Estuaries using Radionuclide Budgets and Ratios. Ph.D. Dissertation. Case Western Reserve Univ. 281 pp.

\_\_\_\_\_, G.M. Matisoff, P.J. Whiting, and D.M. Klarer. 2005. Transport of fine sediment through a wetland using radionuclide tracers: Old Woman Creek, OH. J. Great Lakes Res. 31: 56-67.

Windus, J.L. 1995. Old Woman Creek swamp forest monitoring project: 1987-1995. Ohio Dept Natural Resources, Div. Natural Areas and Preserves, Columbus, OH 22pp.



\_\_\_\_\_. 2002. Old Woman Creek swamp monitoring project: 1987-2000. Ohio Dept Natural Resources, Div. Natural Areas and Preserves, Columbus, OH 19pp.

Woods, A.J.C. 1986. Fluvial Erosion, Sedimentation, and Hydraulic Geometry in the Contributing Watershed of Old Woman Creek National Estuarine Sanctuary. Final report submitted to Sanctuary Programs Div. NOAA/NOS, and ODNR, Div. of Natural Areas and Preserves. 140 pp. Reprinted as NOAA Technical Memorandum, NOS MEMD 12. 1987.

Worthy, M.C. 1980. Littoral Zone Processes at Old Woman Creek. M.Sc. Thesis, The Ohio State University.

Wright, H.E., L.S. Feix, S. Miller, and C.E. Herdendorf. 1991. Spill Response Manual for Old Woman Creek State Nature Preserve and National Estuarine Research Reserve. OWC Technical Report No. 8, ODNR, Division of Natural Areas and Preserves.

Yeo, I.-Y. 2005. Multistage Hierarchical Optimization for Land Use Allocation to Control Nonpoint Source Pollution. Ph.D. Thesis. The Ohio State University. 180pp.

\_\_\_\_\_, J.-M. Guldmann. 2006. Land-use optimization for nonpoint source water pollution control. *Environment and Planning B* 33: 903-921.

\_\_\_\_\_, \_\_\_\_\_, and S.I. Gordon. 2007. A hierarchical optimization approach to watershed land use planning. *Water Resour. Res.* 43: W11416, doi:10.1029/2006WR005315

Zhang, L. 2005. Use of Landsat-7 & Modis Data in Measuring Sediment Concentration in Old Woman Creek. M.Sc. Thesis. The Ohio State University. 150pp.

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**APPENDIX F**

**OWC NERR  
Research List in 2010**

## RESEARCH ACTIVITIES AT OLD WOMAN CREEK NERR – 2010

Glen Bernhardt, Lisa Brohl, and Bradley Phillips – The Collembola of Old Woman Creek SNP and of the Old Woman Creek watershed. This work is a survey of the Collembola, or Springtail, insects of the Old Woman Creek area.

Blanca Bernal-Martinez, William J. Mitsch, and Amanda M. Nahlik/Ohio State University – Carbon sequestration in lotic wetlands in temperate and tropical climates. This work will look at the role of different wetlands (both in the tropics and in the temperate zones) in trapping carbon in the sediments.

Yu-Ping Chin et al./Ohio State University – Reduction of agricultural pesticides in the sediments of a coastal Lake Erie wetland. This work builds on earlier work by Dr. Chin that examined the photolytic breakdown of pesticides in the waters and sediments of Old Woman Creek estuary. This research examines the breakdown rates in various farm ponds and reservoirs in the Dakotas and then will compare rates with the Old Woman Creek estuary.

Linda Cornell/ Bowling Green State University-Firelands – Chemical patterns in the Old Woman Creek estuary. This study is examining the 25+ years of chemical data collected in the monitoring program to determine both annual and spatial trends in this data.

Yinghua Feng / University of Pittsburgh (NERR Fellow 2009) – Sensing Soluble Organics with Microbial Fuel Cells Deployed in an Estuary. This research will explore the use of microbial fuel cells as sentinels for different organic pollutants entering the estuary.

Stan Gehrt, Andrew Kniewski, and Alex Silvis/ Ohio State University – Migratory flight paths of Lasiurine bats along Lake Erie. Lasiurine bats ( Hoary bats, Red bats, and Silver haired bats) were captured and fitted with radio transmitters and then released at four different sites along Lake Erie. This is a multi-year study to determine the flight patterns of these bats as they migrate in the late spring.

Joe Holomuzki/ Ohio State University, Mansfield and Robert Whyte/ California University of Pennsylvania – The impact of Phragmites control techniques on aquatic communities. This work examines the benthic animals associated with *Phragmites* and with *Typha* stands and the impact of herbicides used for controlling *Phragmites* on these animals.

David Klarer/ Old Woman Creek NERR – A survey of algal communities in selected inland reservoirs of Ohio. A survey of the algal flora of selected inland reservoirs is being conducted to provide basic information for proper management of the fishery stock in these reservoirs.

Robert Krebs/ Cleveland State University– A survey of freshwater mussels (Unionidae) and other mollusks in the tributaries of the western basin of Lake Erie with a comparison to the molluscan fauna of Old Woman Creek Estuarine Reserve. This study builds on work done at OWC last year. This year mussels in the nearshore zone of western Lake Erie and the tributaries flowing into this basin will be surveyed to determine the mussel populations in these areas. These populations will be compared to populations found in OWC and neighboring streams last year.

Roger Laushman/Oberlin College – Comparison of genetic variation in the native swamp rose (*Rosa palustris*) and the invasive multiflora rose (*R. multiflora*). This study is examining the hybridization between a native rose and the introduced and invasive rose (*R. multiflora*).

Peter Lavrentyev/ University of Akron, Ken Krieger/ Heidelberg College, Robert Whyte/ California University of Pennsylvania, Scott Lynn/ University of Kentucky, Lisa Park/ University of Akron, and David Klarer/ OWC-ODNR – Taxonomic Atlas of Old Woman Creek Estuary and Adjacent Areas. Work began in 2004 on a long-term project to develop an illustrated atlas of the organisms found in Old Woman Creek and the adjacent zone of Lake Erie. Chapters on several of the aquatic insect groups, the protozoans, and the fish have been completed.

Mark Lazaran/ California University of Pennsylvania – Muskrat populations in Old Woman Creek estuary. A survey of the muskrat houses in the estuary is being conducted. The locations and materials used in construction of the houses are being examined to determine muskrat use of the different plant species in the estuary.

Mark Lazaran/ California University of Pennsylvania – Marsh Wren nesting in two Lake Erie coastal marshes. A survey of marsh wren activity in Old Woman Creek estuary and Sheldon marsh is being conducted to determine the use of these two wetlands by the marsh wren.

Amanda M. Nahlik, William J. Mitsch, and Blanca Bernal-Martinez/Ohio State University – Methane production and emission from lotic wetlands in temperate and tropical areas. This work is determining the rate of methane production and release in a series of lotic wetlands, both in the tropics and in the temperate zones.

Collin Ward/ The Ohio State University (NERR Fellow 2009) – The Accumulation and Photochemical Degradation of Non-point Source Pollutants in organic Surface Microlayers in the waters of OWC estuary. This research examines the role of the air/water interface in the estuary for both trapping selected organic pollutants and then breaking them down.

Robert Whyte/ California University of Pennsylvania – A floristic survey of the Reserve. A vegetative map of the macrophyte communities in the reserve will be developed. This work is on-going and will build on previous work done.

**Old Woman Creek NERR  
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**APPENDIX G**

**OWC NERR  
Technical Reports and Bulletins**

## OWC NERR Technical Report and Bulletin Series

Technical Report #1 Millie, D.F. and D.M. Klarer. 1980. Survey of Epiphytic Diatoms Along the Ohio Coast of Lake Erie. Final report submitted to the ODNR - Ohio Coastal Zone Management Program. 45 pp. OWC Technical Report No.1, ODNR, Div. of Natural Areas & Preserves

Technical Report #2. Klarer, D.M. 1981. Limnological Study of Old Woman Creek National Estuarine Sanctuary for Collection of Baseline Data. Final report C.E.I.P. Program Contract Number 80-103, and ODNR, Div. of Natural Areas and Preserves. 60 pp. OWC Tech. Report No.2, ODNR, Div. of Natural Areas & Preserves

Technical Report #3. Klarer, D.M..1985. An Annotated Species List of the Algae of Old Woman Creek Estuary. OWC Tech. Report No.3, ODNR, Div. of Natural Areas and Preserves. 48 pp.

Technical Report #4. Hoffman, W.S. 1985. The Fishes of Old Woman Creek Estuary. OWC Technical Report No.4, ODNR, Div. of Natural Areas & Preserves. 24 pp. + 1 app.

Technical Report #5. Klarer, D.M. 1988. The Role of a Freshwater Estuary in Mitigating Storm-Water Inflow. OWC Tech. Report No.5, ODNR, Div. of Natural Areas and Preserves. 54 pp. + 1 app.

Technical Report #6. Krieger, K.A., D.M. Klarer, R.T. Heath, and C.E. Herdendorf. 1990. Priorities for Great Lakes Coastal Wetlands Research. Proceedings of a Conference held at Old Woman Creek National Estuarine Research Reserve, Huron, Ohio, 20-21 October 1989. OWC Tech Report No.6, ODNR, Div. of Natural Areas and Preserves.

Technical Report #7. Herdendorf, C.E. and T.M. Hume. 1991. Morphometry and water storage in Old Woman Creek: a freshwater estuary in western Lake Erie. OWC Tech. Report No. 7, ODNR, Division of Natural Areas and Preserves. 22 pp. + 5 app.

Technical Report #8. Wright, H.E., L.S. Feix, S. Miller, and C.E. Herdendorf. 1991. Spill Response Manual for Old Woman Creek State Nature Preserve and National Estuarine Research Reserve. OWC Technical Report No. 8, ODNR, Division of Natural Areas and Preserves.

Technical Report #9. Krieger, K.A. and D.M. Klarer. 1992. Macroinvertebrate Communities of the Old Woman Creek National Estuarine Research Reserve. Final report submitted to the Sanctuaries and Reserves Div.-NOAA/NOS, and ODNR, Div. of Natural Areas and Preserves. 55 pp. and appendices. OWC Tech Report No. 9, ODNR, Div. of Natural Areas and Preserves.

Technical Report #10. Herdendorf, C.E, R.C. Herdendorf, and D.M. Klarer. 1999

(revised 2001). Catalogue of the vascular plants in Old Woman Creek estuary and watershed. OWC Technical Report No. 10. Site Profile Contribution No.1. ODNR, Div. of Natural Areas and Preserves. 112 pp.

Technical Report #11. Herdendorf, C.E, R.C. Herdendorf, and D.M. Klarer. 1999 (revised 2001). Catalogue of the vertebrate fauna of Old Woman Creek estuary, watershed, and environs. OWC Technical Report No. 11. Site Profile Contribution No.2. ODNR, Div. of Natural Areas and Preserves. 73 pp.

Technical Report #12. Herdendorf, C.E, R.C. Herdendorf, and D.M. Klarer. 2000 (revised 2001). Catalogue of the Invertebrate Fauna in Old Woman Creek Estuary, Watershed, and Adjacent Waters of Lake Erie. OWC Technical Report No. 12 (Site Profile Contribution No. 3) Ohio Department of Natural Resources, Division of Natural Areas and Preserves. 130 pp.

Technical Report #13. Klarer, D.M., C.E. Herdendorf, and R.C. Herdendorf 2000 (revised 2001). Catalogue of the Algal Flora and the Lower Plants in Old Woman Creek Estuary, Watershed, and Adjacent Waters of Lake Erie. OWC Technical Report No. 13 (Site Profile Contribution No. 4) Ohio Department of Natural Resources, Division of Natural Areas and Preserves. 133 pp.

Technical Report #14. Herdendorf, C.E, R.C. Herdendorf, and D.M. Klarer. 2000 (revised 2001). Bibliography of Research Publications for Old Woman Creek Estuary, Watershed, and Adjacent Waters of Lake Erie. OWC Technical Report No. 14 (Site Profile Contribution No. 5) Ohio Department of Natural Resources, Division of Natural Areas and Preserves. 74pp.

Technical Report #15. Krieger. K.A. 2001. Effectiveness of a Coastal Wetland in Reducing the Movement of Agricultural Pollutants into Lake Erie. Final Report submitted to Old Woman Creek NERR and Ohio Sea Grant. OWC Technical Report No. 15. Ohio Department of Natural Resources, Division of Natural Areas and Preserves. 247pp.

### **Technical Bulletins**

Wilson, C., G. Matisoff, and P. Whiting 2002. The Movement of Sediment in Old Woman Creek Watershed. OWC Technical Bulletin No. 1.

Trexel-Kroll, D. and D.A. Francko 2005. Changes in the Old Woman Creek Plant Community Following Reduced Water Levels. OWC Technical Bulletin No. 2.

**Old Woman Creek NERR  
Management Plan**

**APPENDIX H**

**Species recorded in and around the OWC NERR**

## 12. APPENDIXES

### APPENDIX A. ALGAL FLORA AND LOWER PLANTS OF OLD WOMAN CREEK ESTUARY, WATERSHED, AND ADJACENT WATERS OF LAKE ERIE

#### KINGDOM MONERA

#### DIVISION CYANOPHYTA (blue-green algae)

#### CLASS CYANOPHYCEAE

#### Order Chroococcales

	Common Name	Family	Location
<i>Aphanocapsa delicatissima</i>	blue-green	Chroococcaceae	ES
<i>Aphanocapsa elachista</i>	blue-green	Chroococcaceae	ES
<i>Aphanocapsa incerta</i>	blue-green	Chroococcaceae	CK
<i>Aphanothece saxicola</i>	blue-green	Chroococcaceae	ES
<i>Chroococcus dispersus</i>	blue-green	Chroococcaceae	CK,ES
<i>Chroococcus minor</i>	blue-green	Chroococcaceae	CK
<i>Chroococcus minutus</i>	blue-green	Chroococcaceae	CK,LE
<i>Chroococcus planctonicus</i>	blue-green	Chroococcaceae	ES
<i>Chroococcus</i> spp.	blue-greens	Chroococcaceae	CK,ES
<i>Coelosphaerium naegelianum</i>	blue-green	Chroococcaceae	ES
<i>Coelosphaerium pallidum</i>	blue-green	Chroococcaceae	ES
<i>Dactylococcopsis irregularis</i>	blue-green	Chroococcaceae	ES
<i>Gloeocapsa aeruginosa</i>	blue-green	Chroococcaceae	CK
<i>Gloeocapsa</i> sp.	blue-green	Chroococcaceae	ES
<i>Gomphosphaeria lacustris</i>	blue-green	Chroococcaceae	ES
<i>Merismopedia glauca</i>	blue-green	Chroococcaceae	ES
<i>Merismopedia minima</i>	blue-green	Chroococcaceae	CK,ES
<i>Merismopedia tenuissima</i>	blue-green	Chroococcaceae	ES
<i>Microcystis aeruginosa</i>	blue-green	Chroococcaceae	ES
<i>Microcystis minutissima</i>	blue-green	Chroococcaceae	ES
<i>Microcystis</i> sp.	blue-green	Chroococcaceae	ES
<i>Rhabdoderma minima</i>	blue-green	Chroococcaceae	ES
<i>Rhabdoderma</i> sp.	blue-green	Chroococcaceae	ES
<i>Synechococcus leopoliensis</i>	blue-green	Chroococcaceae	ES
<i>Synechococcus</i> sp.	blue-green	Chroococcaceae	ES

#### Order Oscillatoriales

<i>Anabaena circinalis</i>	blue-green	Nostocaceae	ES
<i>Anabaena spiroides</i>	blue-green	Nostocaceae	LE
<i>Anabaena spiroides</i> var. <i>crassa</i>	blue-green	Nostocaceae	LE
<i>Anabaena variabilis</i>	blue-green	Nostocaceae	ES
<i>Anabaena</i> spp.	blue-greens	Nostocaceae	ES,LE
<i>Aphanizomenon flos-aquae</i>	blue-green	Nostocaceae	ES,LE
<i>Calothrix fusca</i>	blue-green	Rivulariaceae	CK
<i>Calothrix</i> spp.	blue-greens	Rivulariaceae	CK
<i>Lyngba</i> sp.	blue-green	Oscillatoriaceae	CK,ES
<i>Microcoleus lyngbyaceus</i>	blue-green	Oscillatoriaceae	CK
<i>Oscillatoria agardhii</i>	blue-green	Oscillatoriaceae	ES,LE
<i>Oscillatoria amphibia</i>	blue-green	Oscillatoriaceae	ES
<i>Oscillatoria chlorina</i>	blue-green	Oscillatoriaceae	LE
<i>Oscillatoria granulata</i>	blue-green	Oscillatoriaceae	ES
<i>Oscillatoria hamelii</i>	blue-green	Oscillatoriaceae	ES,LE
<i>Oscillatoria limosa</i>	blue-green	Oscillatoriaceae	CK,ES
<i>Oscillatoria prolifica</i>	blue-green	Oscillatoriaceae	LE
<i>Oscillatoria</i> spp.	blue-greens	Oscillatoriaceae	ES,LE
<i>Oscillatoria subbrevis</i>	blue-green	Oscillatoriaceae	CK,ES
<i>Oscillatoria tenuis</i>	blue-green	Oscillatoriaceae	CK,ES
<i>Phormidium tenue</i>	blue-green	Oscillatoriaceae	ES
<i>Raphidiopsis mediterranea</i>	blue-green	Rivulariaceae	LE
<i>Schizothrix calcicola</i>	blue-green	Oscillatoriaceae	CK,ES
<i>Spirulina</i> sp.	blue-green	Rivulariaceae	ES





Order Centrales (cont'd)	Common Name	Family	Location
<i>Aulacoseira granulata</i>	centric diatom	Melosiraceae	ES
<i>Aulacoseira granulata</i> var. <i>angustissima</i>	centric diatom	Melosiraceae	ES,LE
<i>Aulacoseira islandica</i>	centric diatom	Melosiraceae	E
<i>Aulacoseira italica</i>	centric diatom	Melosiraceae	ES
<i>Aulacoseira</i> spp.	centric diatoms	Melosiraceae	ES
<i>Coscinodiscus</i> sp.	centric diatom	Coscinodiscaceae	ES
<i>Cyclostephanos invisitatus</i>	centric diatom	Thalassiosiraceae	ES
<i>Cyclostephanos tholiformis</i>	centric diatom	Thalassiosiraceae	ES
<i>Cyclotella atomus</i>	centric diatom	Thalassiosiraceae	ES
<i>Cyclotella atomus</i> var. 1	centric diatom	Thalassiosiraceae	ES
<i>Cyclotella meneghiniana</i>	centric diatom	Thalassiosiraceae	ES
<i>Cyclotella meneghiniana</i> var. 1	centric diatom	Thalassiosiraceae	ES
<i>Cyclotella pseudostelligera</i>	centric diatom	Thalassiosiraceae	ES
<i>Cyclotella radiosa</i>	centric diatom	Thalassiosiraceae	ES
<i>Cyclotella stelligera</i>	centric diatom	Thalassiosiraceae	ES
<i>Cyclotella</i> spp.	centric diatoms	Thalassiosiraceae	ES
<i>Melosira varians</i>	centric diatom	Melosiraceae	ES
<i>Rhizolenia eriensis</i>	centric diatom	Rhizoleniaceae	ES
<i>Skeletonema potamos</i>	centric diatom	Thalassiosiraceae	ES
<i>Stephanodiscus alpinus</i>	centric diatom	Coscinodiscaceae	ES
<i>Stephanodiscus binderanus</i>	centric diatom	Coscinodiscaceae	ES,LE
<i>Stephanodiscus hantzschii</i>	centric diatom	Coscinodiscaceae	ES
<i>Stephanodiscus minutulus</i>	centric diatom	Coscinodiscaceae	ES
<i>Stephanodiscus nipigonensis</i>	centric diatom	Coscinodiscaceae	ES
<i>Stephanodiscus parvus</i>	centric diatom	Coscinodiscaceae	ES
<i>Stephanodiscus rotula</i>	centric diatom	Coscinodiscaceae	CK,ES,LE
<i>Stephanodiscus subtilis</i>	centric diatom	Coscinodiscaceae	ES
<i>Stephanodiscus</i> sp.	centric diatom	Coscinodiscaceae	ES
<i>Thalassiosira pseudonana</i>	centric diatom	Thalassiosiraceae	ES
<i>Thalassiosira weissflogii</i>	centric diatom	Thalassiosiraceae	ES
<b>Order Pennales (pennate diatoms)</b>			
<i>Achnanthes biasolettiana</i>	pennate diatom	Achnanthaceae	ES
<i>Achnanthes clevei</i>	pennate diatom	Achnanthaceae	ES
<i>Achnanthes conspicua</i>	pennate diatom	Achnanthaceae	CK
<i>Achnanthes grischuna</i>	pennate diatom	Achnanthaceae	ES
<i>Achnanthes hungarica</i>	pennate diatom	Achnanthaceae	ES
<i>Achnanthes lanceolata</i>	pennate diatom	Achnanthaceae	CK,ES
<i>Achnanthes lanceolata</i> ssp. <i>dubia</i>	pennate diatom	Achnanthaceae	CK,ES
<i>Achnanthes lanceolata</i> ssp. <i>lanceolata</i>	pennate diatom	Achnanthaceae	CK,ES
<i>Achnanthes lanceolata</i> ssp. <i>l.</i> var. <i>boyei</i>	pennate diatom	Achnanthaceae	ES
<i>Achnanthes laurenburgiana</i>	pennate diatom	Achnanthaceae	ES
<i>Achnanthes minutissima</i>	pennate diatom	Achnanthaceae	CK,ES
<i>Achnanthes minutissima</i> var. <i>gracillima</i>	pennate diatom	Achnanthaceae	ES
<i>Achnanthes minutissima</i> var. <i>minutissima</i>	pennate diatom	Achnanthaceae	CK
<i>Achnanthes minutissima</i> var. <i>saprophila</i>	pennate diatom	Achnanthaceae	ES
<i>Achnanthes minutissima</i> var. 2	pennate diatom	Achnanthaceae	ES
<i>Achnanthes</i> sp.	pennate diatom	Achnanthaceae	CK,ES
<i>Amphilpleura pellucida</i>	pennate diatom	Naviculaceae	CK,ES
<i>Amphora montana</i>	pennate diatom	Cymbellaceae	ES
<i>Amphora ovalis</i>	pennate diatom	Cymbellaceae	ES
<i>Amphora pediculus</i>	pennate diatom	Cymbellaceae	CK,ES
<i>Amphora</i> sp.	pennate diatom	Cymbellaceae	ES
<i>Anomoeoneis brachysira</i>	pennate diatom	Naviculaceae	ES
<i>Anomoeoneis sphaerophora</i>	pennate diatom	Naviculaceae	ES
<i>Asterionella formosa</i>	pennate diatom	Fragilariaceae	ES,LE
<i>Caloneis amphisbaena</i>	pennate diatom	Naviculaceae	CK,ES
<i>Caloneis bacillum</i>	pennate diatom	Naviculaceae	CK,ES
<i>Caloneis clevei</i>	pennate diatom	Naviculaceae	ES
<i>Caloneis molaris</i>	pennate diatom	Naviculaceae	ES

Order Pennales (cont'd)	Common Name	Family	Location
<i>Caloneis schumanniana</i>	pennate diatom	Naviculaceae	ES
<i>Caloneis thermalis</i>	pennate diatom	Naviculaceae	ES
<i>Cocconeis pediculus</i>	pennate diatom	Achnantheaceae	ES
<i>Cocconeis placentula</i>	pennate diatom	Achnantheaceae	CK,ES
<i>Cocconeis placentula</i> var. <i>euglypta</i>	pennate diatom	Achnantheaceae	ES
<i>Cocconeis placentula</i> var. <i>lineata</i>	pennate diatom	Achnantheaceae	ES
<i>Cylindrotheca gracilis</i>	pennate diatom	Nitzschiacea	ES
<i>Cymatopleura elliptica</i>	pennate diatom	Surirellacea	CK
<i>Cymatopleura solea</i>	pennate diatom	Surirellacea	ES
<i>Cymbella affinis</i>	pennate diatom	Cymbellaceae	ES
<i>Cymbella caespitosa</i>	pennate diatom	Cymbellaceae	ES
<i>Cymbella microcephala</i>	pennate diatom	Cymbellaceae	ES
<i>Cymbella minuta</i>	pennate diatom	Cymbellaceae	CK,ES
<i>Cymbella naviculiformis</i>	pennate diatom	Cymbellaceae	ES
<i>Cymbella prostrata</i>	pennate diatom	Cymbellaceae	CK
<i>Cymbella silesiaca</i>	pennate diatom	Cymbellaceae	CK,ES
<i>Cymbella triangulum</i>	pennate diatom	Cymbellaceae	LE
<i>Cymbella tumida</i>	pennate diatom	Cymbellaceae	CK,ES
<i>Cymbella tumidula</i>	pennate diatom	Cymbellaceae	CK,ES
<i>Cymbella turgidula</i>	pennate diatom	Cymbellaceae	CK,ES
<i>Denticula kuetzingii</i>	pennate diatom	Epithemiacea	ES
<i>Diatoma vulgare</i> var. <i>distorta</i>	pennate diatom	Fragilariaceae	ES
<i>Diatoma mesodon</i>	pennate diatom	Fragilariaceae	ES
<i>Diatoma tenuis</i>	pennate diatom	Fragilariaceae	ES
<i>Diatoma vulgare</i>	pennate diatom	Fragilariaceae	ES
<i>Entomoneis ornata</i>	pennate diatom	Naviculaceae	LE
<i>Epithemia adnata</i>	pennate diatom	Epithemiacea	ES
<i>Epithemia turgida</i>	pennate diatom	Epithemiacea	ES
<i>Eunotia arcus</i> var. <i>bidens</i>	pennate diatom	Eunotiaceae	ES
<i>Eunotia bilunaris</i> var. <i>bilunaris</i>	pennate diatom	Eunotiaceae	ES
<i>Eunotia bilunaris</i> var. <i>mucophila</i>	pennate diatom	Eunotiaceae	ES
<i>Eunotia denticulata</i>	pennate diatom	Eunotiaceae	ES
<i>Eunotia diodon</i>	pennate diatom	Eunotiaceae	ES
<i>Eunotia exigua</i>	pennate diatom	Eunotiaceae	ES
<i>Eunotia formica</i>	pennate diatom	Eunotiaceae	ES
<i>Eunotia pectinalis</i>	pennate diatom	Eunotiaceae	ES
<i>Eunotia</i> sp.	pennate diatom	Eunotiaceae	ES
<i>Fragilaria capucina</i>	pennate diatom	Fragilariaceae	CK,ES,LE
<i>Fragilaria capucina</i> var. <i>gracilis</i>	pennate diatom	Fragilariaceae	ES
<i>Fragilaria capucina</i> var. <i>radians</i>	pennate diatom	Fragilariaceae	ES
<i>Fragilaria capucina</i> var. <i>rumpens</i>	pennate diatom	Fragilariaceae	CK,ES
<i>Fragilaria capucina</i> var. <i>vaucheriae</i>	pennate diatom	Fragilariaceae	CK,ES
<i>Fragilaria construens</i>	pennate diatom	Fragilariaceae	ES
<i>Fragilaria construens</i> f. <i>venter</i>	pennate diatom	Fragilariaceae	CK,ES
<i>Fragilaria crotonensis</i>	pennate diatom	Fragilariaceae	ES,LE
<i>Fragilaria fasciculata</i>	pennate diatom	Fragilariaceae	CK,ES
<i>Fragilaria leptostauron</i> var. <i>martyi</i>	pennate diatom	Fragilariaceae	ES
<i>Fragilaria parasitica</i> var. <i>subconstricta</i>	pennate diatom	Fragilariaceae	ES
<i>Fragilaria pulchella</i>	pennate diatom	Fragilariaceae	ES
<i>Fragilaria tenera</i>	pennate diatom	Fragilariaceae	ES
<i>Fragilaria ulna</i>	pennate diatom	Fragilariaceae	CK,ES
<i>Fragilaria ulna</i> var. <i>acus</i>	pennate diatom	Fragilariaceae	ES
<i>Fragilaria ulna</i> var. <i>danica</i>	pennate diatom	Fragilariaceae	ES
<i>Fragilaria ulna</i> var. <i>obtusa</i>	pennate diatom	Fragilariaceae	CK
<i>Fragilaria ulna</i> var. <i>oxyrhynchus</i>	pennate diatom	Fragilariaceae	CK
<i>Fragilaria ulna</i> var. 1	pennate diatom	Fragilariaceae	ES
<i>Fragilaria virescens</i>	pennate diatom	Fragilariaceae	CK,ES
<i>Frustulia rhomboides</i>	pennate diatom	Naviculaceae	ES
<i>Frustulia vulgaris</i>	pennate diatom	Naviculaceae	ES
<i>Gomphonema acuminatum</i>	pennate diatom	Cymbellaceae	ES

Order Pennales (cont'd)	Common Name	Family	Location
<i>Gomphonema affine</i>	pennate diatom	Cymbellaceae	CK,ES
<i>Gomphonema affine</i> var. <i>elongatum</i>	pennate diatom	Cymbellaceae	ES
<i>Gomphonema amoenum</i>	pennate diatom	Cymbellaceae	ES
<i>Gomphonema angustatum</i>	pennate diatom	Cymbellaceae	CK,ES
<i>Gomphonema angustatum</i> var. <i>citera</i>	pennate diatom	Cymbellaceae	CK
<i>Gomphonema a.</i> var. <i>sarcophogus</i>	pennate diatom	Cymbellaceae	ES
<i>Gomphonema angustum</i>	pennate diatom	Cymbellaceae	CK,ES
<i>Gomphonema augar</i> var. <i>spaerophorum</i>	pennate diatom	Cymbellaceae	CK
<i>Gomphonema augur</i>	pennate diatom	Cymbellaceae	CK,ES
<i>Gomphonema clavatum</i>	pennate diatom	Cymbellaceae	ES
<i>Gomphonema clevei</i>	pennate diatom	Cymbellaceae	ES
<i>Gomphonema dichotomum</i>	pennate diatom	Cymbellaceae	ES
<i>Gomphonema gracile</i>	pennate diatom	Cymbellaceae	ES
<i>Gomphonema minutum</i>	pennate diatom	Cymbellaceae	ES
<i>Gomphonema minutum</i> f. <i>lamanense</i>	pennate diatom	Cymbellaceae	ES
<i>Gomphonema olivaceum</i>	pennate diatom	Cymbellaceae	CK,ES
<i>Gomphonema parvulum</i>	pennate diatom	Cymbellaceae	CK,ES
<i>Gomphonema truncatum</i>	pennate diatom	Cymbellaceae	ES
<i>Gomphonema truncatum</i> var. <i>elongata</i>	pennate diatom	Cymbellaceae	ES
<i>Gomphonema</i> sp.	pennate diatom	Cymbellaceae	ES
<i>Gyrosigma acuminatum</i>	pennate diatom	Naviculaceae	CK
<i>Gyrosigma attenuatum</i>	pennate diatom	Naviculaceae	ES
<i>Gyrosigma exilis</i>	pennate diatom	Naviculaceae	ES
<i>Gyrosigma scalproides</i>	pennate diatom	Naviculaceae	ES
<i>Gyrosigma</i> sp.	pennate diatom	Naviculaceae	ES
<i>Hantzschia amphioxys</i>	pennate diatom	Nitzschiacea	ES
<i>Meridion circulare</i>	pennate diatom	Fragilariaceae	CK,ES
<i>Meridion circulare</i> var. <i>constrictum</i>	pennate diatom	Fragilariaceae	ES
<i>Navicula absoluta</i>	pennate diatom	Naviculaceae	ES
<i>Navicula agnita</i>	pennate diatom	Naviculaceae	ES
<i>Navicula arvensis</i>	pennate diatom	Naviculaceae	ES
<i>Navicula atomus</i>	pennate diatom	Naviculaceae	ES
<i>Navicula atomus</i> var. <i>permitis</i>	pennate diatom	Naviculaceae	ES
<i>Navicula bacillum</i>	pennate diatom	Naviculaceae	ES
<i>Navicula bahusiensis</i>	pennate diatom	Naviculaceae	ES
<i>Navicula capitata</i>	pennate diatom	Naviculaceae	ES
<i>Navicula capitata</i> var. <i>capitata</i>	pennate diatom	Naviculaceae	ES
<i>Navicula capitatoradiata</i>	pennate diatom	Naviculaceae	ES
<i>Navicula cincta</i>	pennate diatom	Naviculaceae	ES
<i>Navicula confervacea</i>	pennate diatom	Naviculaceae	ES
<i>Navicula contenta</i>	pennate diatom	Naviculaceae	ES
<i>Navicula cryptocephala</i>	pennate diatom	Naviculaceae	ES
<i>Navicula cryptotenella</i>	pennate diatom	Naviculaceae	CK,ES
<i>Navicula cuspidata</i>	pennate diatom	Naviculaceae	CK,ES
<i>Navicula decussis</i>	pennate diatom	Naviculaceae	CK,ES
<i>Navicula elginensis</i>	pennate diatom	Naviculaceae	CK,ES
<i>Navicula erifuga</i>	pennate diatom	Naviculaceae	ES
<i>Navicula goeppertiana</i>	pennate diatom	Naviculaceae	ES
<i>Navicula goeppertiana</i> var. <i>goeppertiana</i>	pennate diatom	Naviculaceae	ES
<i>Navicula goeppertiana</i> var. <i>monita</i>	pennate diatom	Naviculaceae	ES
<i>Navicula gregaria</i>	pennate diatom	Naviculaceae	CK,ES
<i>Navicula grunowii</i> var. 1	pennate diatom	Naviculaceae	ES
<i>Navicula halophila</i>	pennate diatom	Naviculaceae	ES
<i>Navicula heimansii</i>	pennate diatom	Naviculaceae	ES
<i>Navicula hustedtii</i>	pennate diatom	Naviculaceae	ES
<i>Navicula ingenua</i>	pennate diatom	Naviculaceae	ES
<i>Navicula insocibilis</i>	pennate diatom	Naviculaceae	ES
<i>Navicula integra</i>	pennate diatom	Naviculaceae	ES
<i>Navicula lanceolata</i>	pennate diatom	Naviculaceae	CK,ES
<i>Navicula menisculus</i>	pennate diatom	Naviculaceae	ES

Order Pennales (cont'd)	Common Name	Family	Location
<i>Navicula menisculus</i> var. <i>grunowii</i>	pennate diatom	Naviculaceae	ES
<i>Navicula menisculus</i> var. <i>upsaliensis</i>	pennate diatom	Naviculaceae	CK,ES
<i>Navicula minima</i>	pennate diatom	Naviculaceae	CK,ES
<i>Navicula minima</i> var. <i>pseudofossalis</i>	pennate diatom	Naviculaceae	ES
<i>Navicula minusculoides</i>	pennate diatom	Naviculaceae	ES
<i>Navicula molestiformis</i>	pennate diatom	Naviculaceae	ES
<i>Navicula monoculata</i>	pennate diatom	Naviculaceae	ES
<i>Navicula mutica</i>	pennate diatom	Naviculaceae	ES
<i>Navicula mutica</i> var. <i>ventricosa</i>	pennate diatom	Naviculaceae	ES
<i>Navicula pelliculosa</i>	pennate diatom	Naviculaceae	ES
<i>Navicula praeterita</i>	pennate diatom	Naviculaceae	ES
<i>Navicula pseudolanceolata</i>	pennate diatom	Naviculaceae	ES
<i>Navicula pupula</i>	pennate diatom	Naviculaceae	ES
<i>Navicula pupula</i> var. <i>aquaeductae</i>	pennate diatom	Naviculaceae	ES
<i>Navicula pupula</i> var. <i>rectangularis</i>	pennate diatom	Naviculaceae	ES
<i>Navicula pygmaea</i>	pennate diatom	Naviculaceae	ES
<i>Navicula radiosa</i>	pennate diatom	Naviculaceae	ES
<i>Navicula recens</i>	pennate diatom	Naviculaceae	ES
<i>Navicula rhynchocephala</i>	pennate diatom	Naviculaceae	ES
<i>Navicula salinarum</i>	pennate diatom	Naviculaceae	CK,ES
<i>Navicula saprophila</i>	pennate diatom	Naviculaceae	CK,ES
<i>Navicula schroeterii</i>	pennate diatom	Naviculaceae	ES
<i>Navicula seminulum</i>	pennate diatom	Naviculaceae	ES
<i>Navicula similis</i>	pennate diatom	Naviculaceae	ES
<i>Navicula splendidula</i>	pennate diatom	Naviculaceae	ES
<i>Navicula subminuscula</i>	pennate diatom	Naviculaceae	ES
<i>Navicula submolesta</i>	pennate diatom	Naviculaceae	ES
<i>Navicula tenelloides</i>	pennate diatom	Naviculaceae	ES
<i>Navicula tenera</i>	pennate diatom	Naviculaceae	ES
<i>Navicula tripunctata</i>	pennate diatom	Naviculaceae	CK,ES
<i>Navicula tripunctata</i> var. <i>schizonemoides</i>	pennate diatom	Naviculaceae	ES
<i>Navicula trivialis</i>	pennate diatom	Naviculaceae	ES
<i>Navicula vaucherie</i>	pennate diatom	Naviculaceae	ES
<i>Navicula veneta</i>	pennate diatom	Naviculaceae	CK,ES
<i>Navicula viridula</i>	pennate diatom	Naviculaceae	ES
<i>Navicula viridula</i> var. <i>germainii</i>	pennate diatom	Naviculaceae	CK,ES
<i>Navicula viridula</i> var. <i>rostellata</i>	pennate diatom	Naviculaceae	CK,ES
<i>Navicula viridula</i> var. 1	pennate diatom	Naviculaceae	ES
<i>Navicula</i> spp.	pennate diatoms	Naviculaceae	ES
<i>Nedium affine</i>	pennate diatom	Naviculaceae	ES
<i>Nedium dubium</i>	pennate diatom	Naviculaceae	ES
<i>Nitzschia acicularis</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia acidoclinata</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia acuminata</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia admissoides</i>	pennate diatom	Nitzschiacea	CK
<i>Nitzschia agnita</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia amphibia</i>	pennate diatom	Nitzschiacea	CK,ES
<i>Nitzschia angustata</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia angustatula</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia angustiforaminata</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia bita?</i>	pennate diatom	Nitzschiacea	CK
<i>Nitzschia brevissima</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia capitellata</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia clausii</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia closterium</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia communis</i>	pennate diatom	Nitzschiacea	CK,ES
<i>Nitzschia commutatoides</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia compressa</i> var. <i>vexans</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia constricta</i>	pennate diatom	Nitzschiacea	CK
<i>Nitzschia dissipata</i>	pennate diatom	Nitzschiacea	CK,ES

Order Pennales (cont'd)	Common Name	Family	Location
<i>Nitzschia dissipata</i> var. <i>media</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia dubia</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia filiformis</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia fonticola</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia frustulum</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia frustulum</i> var. <i>perpusilla</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia fruticosa</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia gracilis</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia hantzschiana</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia hungarica</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia inconspicua</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia intermedia</i>	pennate diatom	Nitzschiacea	CK,ES
<i>Nitzschia levidensis</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia linearis</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia linearis</i> var. <i>subtilis</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia littoralis</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia microcephala</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia nereidis</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia palea</i>	pennate diatom	Nitzschiacea	CK,ES
<i>Nitzschia palea</i> var. <i>minuta</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia paleacea</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia parvula</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia perspicua</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia plana</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia pusilla</i>	pennate diatom	Nitzschiacea	CK,ES
<i>Nitzschia recta</i>	pennate diatom	Nitzschiacea	CK,ES
<i>Nitzschia reversa</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia sigma</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia sigmoidea</i>	pennate diatom	Nitzschiacea	CK,ES
<i>Nitzschia sinuata</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia sinuata</i> var. <i>tabellaria</i>	pennate diatom	Nitzschiacea	CK,ES
<i>Nitzschia sociabilis</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia solita</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia spiculum</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia stricta</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia subacicularis</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia supralitorea</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia tropica</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia tryblionella</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia tubicola</i>	pennate diatom	Nitzschiacea	ES
<i>Nitzschia valga</i>	pennate diatom	Nitzschiacea	ES
<i>Pinnularia abaujensis</i> var. <i>rostrata</i>	pennate diatom	Naviculaceae	ES
<i>Pinnularia borealis</i>	pennate diatom	Naviculaceae	LE
<i>Pinnularia intermedia</i>	pennate diatom	Naviculaceae	ES
<i>Pinnularia microstauron</i>	pennate diatom	Naviculaceae	ES
<i>Pinnularia microstauron</i> var. <i>brebissonii</i>	pennate diatom	Naviculaceae	ES
<i>Pinnularia microstauron</i> var. <i>b. f. diminuta</i>	pennate diatom	Naviculaceae	ES
<i>Pinnularia nodosa</i>	pennate diatom	Naviculaceae	ES
<i>Pinnularia obscura</i>	pennate diatom	Naviculaceae	ES
<i>Pinnularia stomatophora</i>	pennate diatom	Naviculaceae	ES
<i>Pinnularia viridis</i>	pennate diatom	Naviculaceae	ES
<i>Pinnularia</i> sp.	pennate diatom	Naviculaceae	ES
<i>Plagiotropis lepidoptera</i> var. <i>probosidea</i>	pennate diatom	Naviculaceae	ES
<i>Pleurosigma delicatulum</i>	pennate diatom	Naviculaceae	CK
<i>Reimeria sinuata</i>	pennate diatom	Cymbellaceae	CK,ES
<i>Rhoicosphenia abbreviata</i>	pennate diatom	Achnanthaceae	CK,ES
<i>Stauroneis anceps</i>	pennate diatom	Naviculaceae	ES
<i>Stauroneis kriegeri</i>	pennate diatom	Naviculaceae	ES
<i>Stauroneis phoenicenteron</i>	pennate diatom	Naviculaceae	ES
<i>Stauroneis smithii</i>	pennate diatom	Naviculaceae	ES

Order Pennales (cont'd)	Common Name	Family	Location
<i>Stauroneis thermicola</i>	pennate diatom	Naviculaceae	ES
<i>Surirella angusta</i>	pennate diatom	Surirellaceae	ES
<i>Surirella brebissonii</i> var. <i>kuetzingii</i>	pennate diatom	Surirellaceae	ES
<i>Surirella minuta</i>	pennate diatom	Surirellaceae	CK,ES
<i>Surirella ovalis</i>	pennate diatom	Surirellaceae	ES
<i>Surirella suecica</i>	pennate diatom	Surirellaceae	ES
<i>Surirella tenera</i>	pennate diatom	Surirellaceae	ES
<i>Surirella turgida</i>	pennate diatom	Surirellaceae	ES
<i>Tabellaria fenestrata</i>	pennate diatom	Fragilariaceae	ES
<i>Tabellaria</i> sp.	pennate diatom	Fragilariaceae	ES
<b>DIVISION PYRRHOPHYTA (fire algae)</b>			
<b>CLASS DINOPHYCEAE (dinoflagellates)</b>			
<b>Order Gymnodiniales</b>			
<i>Gymnodinium aeruginosum</i>	dinoflagellate	Gymnodiniaceae	ES
<i>Gymnodinium helveticum</i>	dinoflagellate	Gymnodiniaceae	ES
<i>Gymnodinium palustre</i>	dinoflagellate	Gymnodiniaceae	ES
<i>Gymnodinium</i> spp.	dinoflagellates	Gymnodiniaceae	CK,ES
<i>Katodinium fungiforme</i>	dinoflagellate	Gymnodiniaceae	ES
<b>Order Peridinales</b>			
<i>Ceratium hirundinella</i>	dinoflagellate	Ceratiaceae	ES,LE
<i>Ceratium</i> sp.	dinoflagellate	Ceratiaceae	ES
<i>Glenodinium</i> sp.	dinoflagellate	Peridiniaceae	ES
<i>Peridiniopsis quadridens</i>	dinoflagellate	Peridiniaceae	ES
<i>Woloszynskia coronata</i>	dinoflagellate	Lophodiniaceae	ES
<b>DIVISION CRYPTOPHYTA (cryptomonads)</b>			
<b>CLASS CRYPTOPHYCEAE</b>			
<b>Order Cryptomonadales</b>			
<i>Chilomonas</i> sp.	cryptomonad	Cryptomonadaceae	ES
<i>Chroomonas norstedtii</i>	cryptomonad	Cryptomonadaceae	ES
<i>Chroomonas</i> sp.	cryptomonad	Cryptomonadaceae	ES
<i>Cryptomonas compressa</i>	cryptomonad	Cryptomonadaceae	ES
<i>Cryptomonas erosa</i>	cryptomonad	Cryptomonadaceae	ES
<i>Cryptomonas erosa</i> var. <i>reflexa</i>	cryptomonad	Cryptomonadaceae	CK
<i>Cryptomonas marssonii</i>	cryptomonad	Cryptomonadaceae	ES
<i>Cryptomonas obovata</i>	cryptomonad	Cryptomonadaceae	ES
<i>Cryptomonas ovata</i>	cryptomonad	Cryptomonadaceae	ES
<i>Cryptomonas reflexa</i>	cryptomonad	Cryptomonadaceae	ES
<i>Cryptomonas tenuis</i>	cryptomonad	Cryptomonadaceae	ES
<i>Cryptomonas tetrapyrenoidosa</i>	cryptomonad	Cryptomonadaceae	ES
<i>Cryptomonas</i> spp.	cryptomonads	Cryptomonadaceae	ES
<i>Cyathomonas truncata</i>	cryptomonad	Cyathomonadaceae	ES
<i>Cyathomonas</i> sp.	cryptomonad	Cyathomonadaceae	ES
<i>Planonephros parvula</i>	cryptomonad	Hemiselmidae	ES
<i>Rhodomonas lacustris</i>	cryptomonad	Cryptomonadaceae	ES
<i>Rhodomonas lens</i>	cryptomonad	Cryptomonadaceae	ES
<i>Rhodomonas minuta</i>	cryptomonad	Cryptomonadaceae	ES
<i>Rhodomonas m.</i> var. <i>nannoplanctonica</i>	cryptomonad	Cryptomonadaceae	ES,LE
<i>Rhodomonas</i> spp.	cryptomonads	Cryptomonadaceae	CK,ES
<b>DIVISION EUGLENOPHYTA (euglenoids)</b>			
<b>CLASS EUGLENOPHYCEAE</b>			
<b>Order Euglenales (green euglenas)</b>			
<i>Ascoglena vaginicola</i>	euglenoid	Euglenaceae	ES
<i>Ascoglena</i> sp.	euglenoid	Euglenaceae	ES
<i>Astasia klebsii</i>	euglenoid	Astaciaceae	ES
<i>Astasia</i> spp.	euglenoids	Astaciaceae	ES
<i>Euglena acus</i>	euglenoid	Euglenaceae	ES
<i>Euglena bellovacensis</i>	euglenoid	Euglenaceae	ES

Order Euglenales (cont'd)	Common Name	Family	Location
<i>Euglena deses</i>	euglenoid	Euglenaceae	ES
<i>Euglena ehrenbergii</i>	euglenoid	Euglenaceae	ES
<i>Euglena elastica</i>	euglenoid	Euglenaceae	ES
<i>Euglena fronsundulata</i>	euglenoid	Euglenaceae	ES
<i>Euglena gasterosteus</i>	euglenoid	Euglenaceae	CK,ES
<i>Euglena gracilis</i>	euglenoid	Euglenaceae	ES
<i>Euglena ignobilis</i>	euglenoid	Euglenaceae	ES
<i>Euglena minima</i>	euglenoid	Euglenaceae	ES
<i>Euglena oxyuris</i>	euglenoid	Euglenaceae	ES
<i>Euglena oxyuris</i> var. <i>minima</i>	euglenoid	Euglenaceae	ES
<i>Euglena oxyuris</i> var. <i>minor</i>	euglenoid	Euglenaceae	ES
<i>Euglena pisciformis</i>	euglenoid	Euglenaceae	ES
<i>Euglena proxima</i>	euglenoid	Euglenaceae	ES
<i>Euglena spathirhyncha</i>	euglenoid	Euglenaceae	ES
<i>Euglena spirogyra</i>	euglenoid	Euglenaceae	ES
<i>Euglena tripteris</i>	euglenoid	Euglenaceae	ES
<i>Euglena vermiformis</i>	euglenoid	Euglenaceae	ES
<i>Euglena</i> spp.	euglenoids	Euglenaceae	CK,ES
<i>Lepocinclis ovum</i>	euglenoid	Euglenaceae	ES
<i>Lepocinclis ovum</i> f. <i>typica</i>	euglenoid	Euglenaceae	ES
<i>Lepocinclis ovum</i> var. <i>deflandriana</i>	euglenoid	Euglenaceae	ES
<i>Lepocinclis ovum</i> var. <i>dimidio-minor</i>	euglenoid	Euglenaceae	ES
<i>Lepocinclis ovum</i> var. <i>ovata</i> f. <i>ecaudata</i>	euglenoid	Euglenaceae	ES
<i>Lepocinclis texta</i> f. <i>minor</i>	euglenoid	Euglenaceae	ES
<i>Lepocinclis</i> spp.	euglenoids	Euglenaceae	CK,ES
<i>Phacus acuminatus</i>	euglenoid	Euglenaceae	CK,ES
<i>Phacus arnoldi</i>	euglenoid	Euglenaceae	ES
<i>Phacus caudatus</i>	euglenoid	Euglenaceae	ES
<i>Phacus contortus</i>	euglenoid	Euglenaceae	ES
<i>Phacus curvicauda</i>	euglenoid	Euglenaceae	ES
<i>Phacus helikoides</i>	euglenoid	Euglenaceae	ES
<i>Phacus longicauda</i>	euglenoid	Euglenaceae	ES
<i>Phacus obicularis</i>	euglenoid	Euglenaceae	ES
<i>Phacus pleuronectes</i>	euglenoid	Euglenaceae	ES
<i>Phacus pseudonordstedii</i>	euglenoid	Euglenaceae	ES
<i>Phacus rudicula</i>	euglenoid	Euglenaceae	ES
<i>Phacus tortus</i>	euglenoid	Euglenaceae	ES
<i>Phacus triqueter</i>	euglenoid	Euglenaceae	ES
<i>Phacus</i> sp.	euglenoid	Euglenaceae	ES
<i>Scytomonas</i> sp.	euglenoid	Astaciaceae	ES
<i>Strombomonas acuminata</i>	euglenoid	Euglenaceae	ES
<i>Strombomonas fluviatilis</i>	euglenoid	Euglenaceae	ES
<i>Strombomonas gibberosa</i>	euglenoid	Euglenaceae	ES
<i>Strombomonas longicauda</i>	euglenoid	Euglenaceae	ES
<i>Strombomonas schauinslandii</i>	euglenoid	Euglenaceae	ES
<i>Strombomonas verrucosa</i> var. <i>zmiewika</i>	euglenoid	Euglenaceae	ES
<i>Strombomonas</i> sp.	euglenoid	Euglenaceae	ES
<i>Trachelomonas abrupta</i> var. <i>minor</i>	euglenoid	Euglenaceae	ES
<i>Trachelomonas armata</i>	euglenoid	Euglenaceae	ES
<i>Trachelomonas bulla</i>	euglenoid	Euglenaceae	ES
<i>Trachelomonas crebea</i>	euglenoid	Euglenaceae	ES
<i>Trachelomonas granulosa</i>	euglenoid	Euglenaceae	ES
<i>Trachelomonas hispida</i>	euglenoid	Euglenaceae	ES
<i>Trachelomonas horrida</i>	euglenoid	Euglenaceae	ES
<i>Trachelomonas lacustris</i>	euglenoid	Euglenaceae	ES
<i>Trachelomonas oblonga</i>	euglenoid	Euglenaceae	ES
<i>Trachelomonas oblonga</i> var. <i>attenuata</i>	euglenoid	Euglenaceae	ES
<i>Trachelomonas oblonga</i> var. <i>truncata</i>	euglenoid	Euglenaceae	ES
<i>Trachelomonas</i> o. var. <i>umbilicophora</i>	euglenoid	Euglenaceae	ES
<i>Trachelomonas planctonica</i>	euglenoid	Euglenaceae	ES



Order Euglenales (cont'd)	Common Name	Family	Location
<i>Trachelomonas scabra</i>	euglenoid	Euglenaceae	ES
<i>Trachelomonas spiralis</i>	euglenoid	Euglenaceae	ES
<i>Trachelomonas superba</i>	euglenoid	Euglenaceae	ES
<i>Trachelomonas varians</i>	euglenoid	Euglenaceae	ES
<i>Trachelomonas volvocina</i>	euglenoid	Euglenaceae	ES
<i>Trachelomonas volvocina</i> var. <i>minuta</i>	euglenoid	Euglenaceae	ES
<i>Trachelomonas</i> spp.	euglenoids	Euglenaceae	ES
<i>Urceolus ovatus</i>	euglenoid	Astaciaceae	ES
<i>Urceolus sabulosus</i>	euglenoid	Astaciaceae	ES
<b>Order Rhabdomonadales</b>			
<i>Menoidium gibbum</i>	euglenoid	Rhabdomonaceae	ES
<i>Rhabdomonas</i> sp.	euglenoid	Rhabdomonaceae	ES
<b>DIVISION CHLOROPHYTA (green algae)</b>			
<b>CLASS CHLOROPHYCEAE</b>			
<b>Order Volvocales</b>			
<i>Carteria bourrellyi</i>	green alga	Chlamydomonadaceae	ES
<i>Carteria globosa</i>	green alga	Chlamydomonadaceae	ES
<i>Carteria wisconsinensis</i>	green alga	Chlamydomonadaceae	CK,ES
<i>Carteria</i> sp.	green alga	Chlamydomonadaceae	ES
<i>Chlamydomonas globosa</i>	green alga	Chlamydomonadaceae	CK,ES
<i>Chlamydomonas gracilis</i>	green alga	Chlamydomonadaceae	ES
<i>Chlamydomonas monadina</i>	green alga	Chlamydomonadaceae	ES
<i>Chlamydomonas reinhardtii</i>	green alga	Chlamydomonadaceae	ES
<i>Chlamydomonas subasymmetrica</i>	green alga	Chlamydomonadaceae	ES
<i>Chlamydomonas</i> spp.	green algae	Chlamydomonadaceae	CK,ES,LE
<i>Chlamydonephris excavata</i>	green alga	Chlamydomonadaceae	ES
<i>Chlorogonium elongatum</i>	green alga	Chlamydomonadaceae	ES
<i>Chlorogonium euchlorum</i>	green alga	Chlamydomonadaceae	ES
<i>Chlorogonium hyalinum</i>	green alga	Chlamydomonadaceae	ES
<i>Eudorina elegans</i>	green alga	Volvocaceae	LE
<i>Haematococcus pluvialis</i>	green alga	Chlamydomonadaceae	ES
<i>Pandorinamorum</i>	green alga	Volvocaceae	ES
<i>Pandorina</i> sp.	green alga	Volvocaceae	ES
<i>Pedinopera</i> sp.	green alga	Phacotaceae	ES
<i>Phacotus lenticularis</i>	green alga	Phacotaceae	ES
<i>Phacotus</i> sp.	green alga	Phacotaceae	ES
<i>Pteromonas angulosa</i>	green alga	Phacotaceae	ES
<i>Pteromonas</i> sp.	green alga	Phacotaceae	ES
<i>Sphaerellopsis</i> spp.	green algae	Chlamydomonadaceae	ES
<i>Volvox</i> sp.	green alga	Volvocaceae	ES
<b>Order Tetrasporales</b>			
<i>Chlamydocapsa ampla</i>	green alga	Palmellaceae	CK,ES
<i>Chlamydocapsa planctonica</i>	green alga	Palmellaceae	ES
<i>Chlamydocapsa</i> sp.	green alga	Palmellaceae	ES
<i>Gloeocystis vesiculosa</i>	green alga	Palmellaceae	CK,ES
<i>Pseudosphaerocystis lacustris</i>	green alga	Palmellaceae	CK,ES
<b>Order Chlorococcales</b>			
<i>Actinastrum hantzschii</i>	green alga	Scenedesmaceae	ES
<i>Ankistrodesmus falcatus</i>	green alga	Oocystaceae	ES
<i>Ankistrodesmus stipitatus</i>	green alga	Oocystaceae	ES
<i>Ankyra judayi</i>	green alga	Chlorococcaceae	ES
<i>Characium curvatum</i>	green alga	Chlorococcaceae	ES
<i>Characium</i> sp.	green alga	Chlorococcaceae	ES
<i>Chlorococcum</i> sp.	green alga	Chlorococcaceae	ES
<i>Closteriopsis acicularis</i>	green alga	Oocystaceae	ES
<i>Coelastrum astroidenum</i>	green alga	Scenedesmaceae	ES
<i>Coelastrum cambricum</i>	green alga	Scenedesmaceae	ES

Order Chlorococcales (cont'd)	Common Name	Family	Location
<i>Coelastrum microporum</i>	green alga	Scenedesmaceae	ES
<i>Coelastrum pseucomicroporum</i>	green alga	Scenedesmaceae	ES
<i>Coelastrum</i> sp.	green alga	Scenedesmaceae	ES
<i>Crucigenia fenestrata</i>	green alga	Scenedesmaceae	ES
<i>Crucigenia mucronata</i>	green alga	Scenedesmaceae	ES
<i>Crucigenia quadrata</i>	green alga	Scenedesmaceae	ES
<i>Crucigenia tetrapedia</i>	green alga	Scenedesmaceae	ES
<i>Crucigeniella apiculata</i>	green alga	Scenedesmaceae	ES
<i>Crucigeniella rectangularis</i>	green alga	Scenedesmaceae	ES
<i>Dictyosphaerium puchellum</i>	green alga	Dictyosphaeriaceae	ES
<i>Didymocystis inconspicua</i>	green alga	Scenedesmaceae	ES
<i>Didymocystis planctonicus</i>	green alga	Scenedesmaceae	ES
<i>Didymocystis</i> sp.	green alga	Scenedesmaceae	ES
<i>Didymogenes palatina</i>	green alga	Scenedesmaceae	ES
<i>Franceia droescheri</i>	green alga	Oocystaceae	ES
<i>Golenkinia radiata</i>	green alga	Micractiniaceae	ES
<i>Golenkiniopsis</i> sp.	green alga	Micractiniaceae	ES
<i>Kirchneriella contorta</i> var. <i>contorta</i>	green alga	Oocystaceae	ES
<i>Kirchneriella contorta</i> var. <i>elegans</i>	green alga	Oocystaceae	ES
<i>Kirchneriella lunaris</i>	green alga	Oocystaceae	ES
<i>Kirchneriella</i> sp.	green alga	Oocystaceae	ES
<i>Korshikoviella limnetica</i>	green alga	Chlorococcaceae	ES
<i>Lagerheimia balatonica</i>	green alga	Oocystaceae	ES
<i>Lagerheimia ciliata</i>	green alga	Oocystaceae	ES
<i>Lagerheimia citrififormis</i>	green alga	Oocystaceae	ES
<i>Lagerheimia genevensis</i>	green alga	Oocystaceae	ES
<i>Lagerheimia marssonii</i>	green alga	Oocystaceae	ES
<i>Lagerheimia subsalsa</i>	green alga	Oocystaceae	ES
<i>Lagerheimia wratislawiensis</i>	green alga	Oocystaceae	ES
<i>Micractinium pusillum</i>	green alga	Micractiniaceae	ES
<i>Monoraphidium arcuatum</i>	green alga	Oocystaceae	ES,LE
<i>Monoraphidium circinale</i>	green alga	Oocystaceae	ES
<i>Monoraphidium contortum</i>	green alga	Oocystaceae	ES
<i>Monoraphidium</i> c. var. <i>convolutum</i>	green alga	Oocystaceae	ES
<i>Monoraphidium griffithii</i>	green alga	Oocystaceae	ES
<i>Monoraphidium komarkovae</i>	green alga	Oocystaceae	ES
<i>Monoraphidium mirabile</i>	green alga	Oocystaceae	ES
<i>Monoraphidium</i> sp.	green alga	Oocystaceae	ES
<i>Neodesmus danubialis</i>	green alga	Scenedesmaceae	ES
<i>Nephrochlamys subsolitaria</i>	green alga	Oocystaceae	ES
<i>Nephrochlamys</i> spp.	green algae	Oocystaceae	ES
<i>Oocystis lacustris</i>	green alga	Oocystaceae	ES,LE
<i>Oocystis novae-semiliae</i>	green alga	Oocystaceae	ES
<i>Oocystis parva</i>	green alga	Oocystaceae	ES
<i>Oocystis pusilla</i>	green alga	Oocystaceae	ES
<i>Oocystis</i> sp.	green alga	Oocystaceae	ES
<i>Pediastrum boryanum</i>	green alga	Hydrodictyaceae	ES
<i>Pediastrum duplex</i>	green alga	Hydrodictyaceae	ES
<i>Pediastrum duplex</i> var. <i>duplex</i>	green alga	Hydrodictyaceae	ES
<i>Pediastrum duplex</i> var. <i>reticulatum</i>	green alga	Hydrodictyaceae	ES
<i>Pediastrum simplex</i>	green alga	Hydrodictyaceae	ES
<i>Pediastrum simplex</i> var. <i>biwaense</i>	green alga	Hydrodictyaceae	ES
<i>Pediastrum simplex</i> var. <i>echinulatum</i>	green alga	Hydrodictyaceae	ES
<i>Pediastrum simplex</i> var. <i>sturmii</i>	green alga	Hydrodictyaceae	ES
<i>Pediastrum tetras</i>	green alga	Hydrodictyaceae	ES
<i>Pediastrum tetras</i> var. <i>tetraodon</i>	green alga	Hydrodictyaceae	ES
<i>Pediastrum</i> sp.	green alga	Hydrodictyaceae	ES
<i>Quadrigula closteroides</i>	green alga	Oocystaceae	ES
<i>Quadrigula lacustris</i>	green alga	Oocystaceae	ES
<i>Scenedesmus acuminatus</i>	green alga	Scenedesmaceae	ES

<b>Order Chlorococcales (cont'd)</b>	<b>Common Name</b>	<b>Family</b>	<b>Location</b>
<i>Scenedesmus acuminatus</i> var. <i>minor</i>	green alga	Scenedesmaceae	ES
<i>Scenedesmus armatus</i>	green alga	Scenedesmaceae	ES
<i>Scenedesmus bicaudatus</i>	green alga	Scenedesmaceae	ES
<i>Scenedesmus bijuga</i>	green alga	Scenedesmaceae	ES
<i>Scenedesmus bijuga</i> var. <i>alternans</i>	green alga	Scenedesmaceae	ES
<i>Scenedesmus brevispina</i>	green alga	Scenedesmaceae	ES
<i>Scenedesmus denticulatus</i>	green alga	Scenedesmaceae	ES
<i>Scenedesmus dimorphus</i>	green alga	Scenedesmaceae	CK,ES
<i>Scenedesmus hystrix</i>	green alga	Scenedesmaceae	ES
<i>Scenedesmus longispina</i>	green alga	Scenedesmaceae	ES
<i>Scenedesmus opoliensis</i>	green alga	Scenedesmaceae	CK,ES
<i>Scenedesmus quadricauda</i>	green alga	Scenedesmaceae	ES
<i>Scenedesmus quadricauda</i> var. <i>longispina</i>	green alga	Scenedesmaceae	ES
<i>Scenedesmus sempervirens</i>	green alga	Scenedesmaceae	ES
<i>Scenedesmus serratus</i>	green alga	Scenedesmaceae	ES
<i>Scenedesmus smithii</i>	green alga	Scenedesmaceae	ES
<i>Scenedesmus sooi?</i>	green alga	Scenedesmaceae	ES
<i>Scenedesmus subspicatus</i>	green alga	Scenedesmaceae	ES
<i>Scenedesmus verrucosus</i>	green alga	Scenedesmaceae	ES
<i>Scenedesmus</i> spp.	green algae	Scenedesmaceae	CK,ES
<i>Schroederia indica</i>	green alga	Chlorococcaceae	LE
<i>Schroederia robusta</i>	green alga	Chlorococcaceae	ES
<i>Schroederia setigera</i>	green alga	Chlorococcaceae	ES
<i>Schroederia spiralis</i>	green alga	Chlorococcaceae	ES
<i>Selenastrum capricornutum</i>	green alga	Oocystaceae	ES
<i>Selenastrum</i> sp.	green alga	Oocystaceae	ES
<i>Tetraedron caudatum</i>	green alga	Chlorococcaceae	ES
<i>Tetraedron incus</i>	green alga	Chlorococcaceae	ES
<i>Tetraedron minimum</i>	green alga	Chlorococcaceae	CK,ES
<i>Tetraedron muticum</i>	green alga	Chlorococcaceae	ES
<i>Tetraedron regulare</i>	green alga	Chlorococcaceae	ES
<i>Tetraedron trigonum</i> var. <i>gracile</i>	green alga	Chlorococcaceae	ES
<i>Tetrastrum elegans</i>	green alga	Scenedesmaceae	ES
<i>Tetrastrum glabrum</i>	green alga	Scenedesmaceae	CK,ES
<i>Tetrastrum heteracanthum</i>	green alga	Scenedesmaceae	ES
<i>Tetrastrum heteracanthum</i> ( <i>elegans</i> f.)	green alga	Scenedesmaceae	ES
<i>Tetrastrum punctatum</i>	green alga	Scenedesmaceae	ES
<i>Tetrastrum staurogeniaeforme</i>	green alga	Scenedesmaceae	ES
<i>Treubaria quadrispina</i>	green alga	Oocystaceae	ES
<i>Treubaria schmidlei</i>	green alga	Oocystaceae	ES
<i>Treubaria triappendiculata</i>	green alga	Oocystaceae	ES
<i>Willea irregularis</i>	green alga	Scenedesmaceae	ES
<b>Order Oedogoniales</b>			
<i>Oedogonium</i> sp.	green alga	Oedogoniaceae	ES
<b>Order Chaetophorales</b>			
<i>Desmococcus olivaceus</i>	green alga	Chaetophoraceae	CK
<i>Draparnaldia glomerata</i>	green alga	Chaetophoraceae	CK,ES
<i>Stigeoclonium farctum</i>	green alga	Chaetophoraceae	ES
<i>Stigeoclonium</i> sp.	green alga	Chaetophoraceae	ES
<i>Stigeoclonium tenue</i>	green alga	Chaetophoraceae	ES
<b>Order Ulotrichales</b>			
<i>Microspora</i> sp.	green alga	Microsporaceae	ES
<i>Microspora stagnorum</i>	green alga	Microsporaceae	ES
<i>Radiofilum conjunctivum</i>	green alga	Ulotrichaceae	CK
<i>Ulothrix</i> sp.	green alga	Ulotrichaceae	ES
<b>Order Ulotrichales (cont'd)</b>			
<i>Ulothrix tenerrima</i>	green alga	Ulotrichaceae	CK
<i>Ulothrix tenuissima</i>	green alga	Ulotrichaceae	CK

Order Cladophorales	Common Name	Family	Location
<i>Cladophora glomerata</i>	green alga	Cladophoraceae	ES,LE
<i>Rhizoclonium hieroglyphicum</i>	green alga	Cladophoraceae	CK
<b>Order Zygnematales</b>			
<i>Closterium aciculare</i> var. <i>aciculare</i>	green alga, desmid	Desmidiaceae	ES
<i>Closterium acutum</i> var. <i>acutum</i>	green alga, desmid	Desmidiaceae	ES
<i>Closterium acutum</i> var. <i>variabile</i>	green alga, desmid	Desmidiaceae	ES
<i>Closterium gracile</i> var. <i>gracile</i>	green alga, desmid	Desmidiaceae	ES
<i>Closterium intermedium</i>	green alga, desmid	Desmidiaceae	CK
<i>Closterium limneticum</i> var. <i>limneticum</i>	green alga, desmid	Desmidiaceae	ES
<i>Closterium macilentum</i> var. <i>macilentum</i>	green alga, desmid	Desmidiaceae	ES
<i>Closterium moniliferum</i> var. <i>moniliferum</i>	green alga, desmid	Desmidiaceae	ES
<i>Closterium</i> spp.	green algae, desmids	Desmidiaceae	ES
<i>Cosmarium formosulum</i>	green alga, desmid	Desmidiaceae	ES
<i>Cosmarium granatum</i>	green alga, desmid	Desmidiaceae	ES
<i>Cosmarium granatum</i> var. <i>granatum</i>	green alga, desmid	Desmidiaceae	ES
<i>Cosmarium granulatum</i> ?	green alga, desmid	Desmidiaceae	ES
<i>Cosmarium</i> spp.	green algae, desmids	Desmidiaceae	ES
<i>Mougeotia</i> sp.	green alga	Zygnemataceae	ES
<i>Spirogyra</i> sp.	green alga	Zygnemataceae	CK,ES
<i>Staurastrum gracile</i>	green alga, desmid	Desmidiaceae	ES
<b>KINGDOM FUNGI</b>			
<b>DIVISION MYXOMYCOTA (mucus molds)</b>			
<b>CLASS MYXOMYCETES (true slime molds)</b>			
<b>Order Physariales (physar slimes)</b>			
<i>Badhamia affinis</i>	slime mold	Physaraceae	RE
<i>Craterium minimum</i>	slime mold	Physaraceae	RE
<i>Diderma crustaceum</i>	slime mold	Didymiaceae	RE
<i>Diderma hemisphericum</i>	slime mold	Didymiaceae	RE
<i>Diderma reticulatum</i>	slime mold	Didymiaceae	RE
<i>Didymium crustaceum</i>	slime mold	Didymiaceae	RE
<i>Didymium iridis</i>	slime mold	Didymiaceae	RE
<i>Didymium melanospermum</i>	slime mold	Didymiaceae	RE
<i>Didymium squamulosum</i>	slime mold	Didymiaceae	RE
<i>Fuligo cinerea</i>	slime mold	Physaraceae	RE
<i>Fuligo violacea</i>	slime mold	Physaraceae	RE
<i>Mucilago spongiosa</i>	slime mold	Didymiaceae	RE
<i>Physarella oblonga</i>	slime mold	Physaraceae	RE
<i>Physarum nutans</i>	slime mold	Physaraceae	RE
<i>Physarum vernum</i>	slime mold	Physaraceae	RE
<i>Physarum viride</i>	slime mold	Physaraceae	RE
<i>Physarum viride</i> var. <i>incanum</i>	slime mold	Physaraceae	RE
<i>Tilmadoche alba</i>	slime mold	Physaraceae	RE
<b>Order Liceales (lice slimes)</b>			
<i>Cribraria intricata</i>	slime mold	Cribrariaceae	RE
<i>Dictydium cancellatum</i>	Japanese-lantern slime	Cribrariaceae	RE
<i>Lindbladia tubulina</i>	slime mold	Cribrariaceae	RE
<i>Lycogala epidendrum</i>	wolf's-milk slime	Reticulariaceae	RE
<i>Lycogala flavo-fuscum</i>	slime mold	Reticulariaceae	RE
<i>Reticularia splendens</i>	slime mold	Reticulariaceae	RE
<i>Tubifera ferruginosa</i>	red raspberry slime	Reticulariaceae	RE
<i>Tubifera microsperma</i>	slime mold	Reticulariaceae	RE
<b>Order Trichiales (trichi slimes)</b>			
<i>Acryodes incarnata</i>	slime mold	Trichiaceae	RE
<i>Arcyria cinerea</i>	slime mold	Trichiaceae	RE

Order Trichiales (cont'd)	Common Name	Family	Location
<i>Arcyria denudata</i>	carnival candy slime	Trichiaceae	RE
<i>Arcyria incarnata</i>	slime mold	Trichiaceae	RE
<i>Arcyria nutans</i>	slime mold	Trichiaceae	RE
<i>Calonema aureum</i>	slime mold	Trichiaceae	RE
<i>Hemitrichia clavata</i>	yellow-fuzz cone slime	Trichiaceae	RE
<i>Hemitrichia intorta</i>	slime mold	Trichiaceae	RE
<i>Hemitrichia stipitata</i>	slime mold	Trichiaceae	RE
<i>Hemitrichia vesparium</i>	slime mold	Trichiaceae	RE
<i>Lachnobolus globosus</i>	slime mold	Trichiaceae	RE
<i>Ophiotheca wrightii</i>	slime mold	Trichiaceae	RE
<i>Perichæna quadrata</i>	slime mold	Trichiaceae	RE
<i>Trichia inconspicua</i>	slime mold	Trichiaceae	RE
<b>Order Stemonitales (stemonit slimes)</b>			
<i>Comatichia laxa</i>	slime mold	Stemonitaceae	RE
<i>Comatichia pulchella</i>	slime mold	Stemonitaceae	RE
<i>Comatrichia stemonitis</i>	slime mold	Stemonitaceae	RE
<i>Diachea leucopodia</i>	white-footed slime	Stemonitaceae	RE
<i>Lamproderma arcyrionema</i>	slime mold	Stemonitaceae	RE
<i>Stemonitis fenestrata</i>	slime mold	Stemonitaceae	RE
<i>Stemonitis fusca</i>	slime mold	Stemonitaceae	RE
<i>Stemonitis herbatica</i>	slime mold	Stemonitaceae	RE
<i>Stemonitis maxima</i>	slime mold	Stemonitaceae	RE
<i>Stemonitis smithii</i>	slime mold	Stemonitaceae	RE
<b>DIVISION PHYCOMYCOTA (algal fungi)</b>			
<b>CLASS CHYTRIDIOMYCETES (chytrids)</b>			
<b>Order Chytridiales</b>			
<i>Entophlyctis aurea</i>	water mold	Phlyctidiaceae	LE,RE
<i>Rozella allomycis</i>	water mold	Olpidiaceae	LE,RE
<i>Synchytrium decipiens</i>	water mold	Synchytriaceae	LE,RE
<b>Order Blastocladiiales</b>			
<i>Allomyces arbuscula</i>	water mold	Blastocladiaceae	LE,RE
<i>Blastocladia globosa</i>	water mold	Blastocladiaceae	LE,RE
<i>Blastocladia pringsheimii</i>	water mold	Blastocladiaceae	LE,RE
<i>Blastocladia ramosa</i>	water mold	Blastocladiaceae	LE,RE
<i>Blastocladia simplex</i>	water mold	Blastocladiaceae	LE,RE
<i>Blastocladia tenuis</i>	water mold	Blastocladiaceae	LE,RE
<b>Order Monoblepharidales</b>			
<i>Gonapodya prolifera</i>	water mold	Gonapodyaceae	LE,RE
<i>Monoblepharis</i> sp.	water mold	Monoblepharidaceae	LE,RE
<b>CLASS OOMYCETES (egg fungi)</b>			
<b>Order Saprolegniaceae</b>			
<i>Achlya americana</i>	water mold	Saprolegniaceae	LE,RE
<i>Achlya bisexualis</i>	water mold	Saprolegniaceae	LE,RE
<i>Achlya debaryana</i>	water mold	Saprolegniaceae	LE,RE
<i>Achlya dubia</i>	water mold	Saprolegniaceae	LE,RE
<i>Achlya flagellata</i>	water mold	Saprolegniaceae	LE,RE
<i>Achlya klebsiana</i>	water mold	Saprolegniaceae	LE,RE
<i>Achlya polyandra</i>	water mold	Saprolegniaceae	LE,RE
<i>Achlya prolifera</i>	water mold	Saprolegniaceae	LE,RE
<i>Achlya proliferoides</i>	water mold	Saprolegniaceae	LE,RE
<i>Achlya rodrigueziana</i>	water mold	Saprolegniaceae	LE,RE
<i>Achlya</i> sp.	water mold	Saprolegniaceae	LE,RE
<i>Aphanomyces euteiches</i>	water mold	Saprolegniaceae	LE,RE
<i>Aphanomyces laevis</i>	water mold	Saprolegniaceae	LE,RE
<i>Aphanomyces scaber</i>	water mold	Saprolegniaceae	LE,RE
<i>Aphanomyces</i> sp.	water mold	Saprolegniaceae	LE,RE
<i>Dictyuchus anomalus</i>	water mold	Saprolegniaceae	LE,RE

Order Saprolegniaceae (cont'd)	Common Name	Family	Location
<i>Dictyuchus missouriensis</i>	water mold	Saprolegniaceae	LE,RE
<i>Dictyuchus monosporus</i>	water mold	Saprolegniaceae	LE,RE
<i>Dictyuchus pseudodictyon</i>	water mold	Saprolegniaceae	LE,RE
<i>Dictyuchus</i> sp.	water mold	Saprolegniaceae	LE,RE
<i>Geolegnia inflata</i>	water mold	Saprolegniaceae	LE,RE
<i>Isoachlya</i> sp.?	water mold	Saprolegniaceae	LE,RE
<i>Leptolegnia subterranea</i>	water mold	Saprolegniaceae	LE,RE
<i>Protoachlya paradoxa</i>	water mold	Saprolegniaceae	LE,RE
<i>Saprolegnia diclina</i>	water mold	Saprolegniaceae	LE,RE
<i>Saprolegnia ferax</i>	water mold	Saprolegniaceae	LE,RE
<i>Saprolegnia monoica</i>	water mold	Saprolegniaceae	LE,RE
<i>Saprolegnia parasitica</i>	water mold	Saprolegniaceae	LE,RE
<i>Saprolegnia</i> sp.	water mold	Saprolegniaceae	LE,RE
<b>Order Leptomitales</b>			
<i>Apodachlya brachynema</i>	water mold	Leptomitaceae	LE,RE
<b>Order Lagenidales</b>			
<i>Olpidiopsis saprolegniae</i>	water mold	Olpidiopsidaceae	LE,RE
<i>Olpidiopsis varians</i>	water mold	Olpidiopsidaceae	LE,RE
<b>Order Peronosporales (downy mildews)</b>			
<i>Cystopus bliti</i>	downy mildew	Peronosporaceae	RE
<i>Cystopus candidus</i>	downy mildew	Peronosporaceae	RE
<i>Peronospora geranii</i>	downy mildew	Peronosporaceae	RE
<i>Peronospora parasitica</i>	downy mildew	Peronosporaceae	RE
<i>Phytophthora cactorum</i>	crown rot	Pythiaceae	CK
<i>Phytophthora undulatum</i>	downy mildew	Pythiaceae	LE,RE
<i>Plasmopara sordida</i>	downy mildew	Peronosporaceae	RE
<i>Plasmopara viticola</i>	downy mildew of grape	Peronosporaceae	CK,ES,RE
<i>Pythium aphanidermatum</i>	downy mildew	Pythiaceae	LE,RE
<i>Pythium cystosiphon?</i>	downy mildew	Pythiaceae	LE,RE
<i>Pythium debaryanum</i>	downy mildew	Pythiaceae	LE,RE
<i>Pythium proliferum</i>	downy mildew	Pythiaceae	LE,RE
<i>Pythium pulchrum</i>	downy mildew	Pythiaceae	LE,RE
<i>Pythium</i> sp.	downy mildew	Pythiaceae	LE,RE
<i>Pythium ultimum</i>	downy mildew	Pythiaceae	LE,RE
<b>CLASS ZYGOMYCETES (pair fungi)</b>			
<b>Order Entomophthorales</b>			
<i>Empusa grylli</i>	mold	Entomophthoraceae	RE
<b>Order Mucorales</b>			
<i>Mucor stolonifer</i>	mold	Mucoraceae	RE
<i>Rhizopus</i> sp.	bread mold	Mucoraceae	CK
<b>DIVISION ASCOMYCOTA (ascomycetes or bladder fungi)</b>			
<b>CLASS HEMIASCOMYCETES (yeasts)</b>			
<b>Order Protomycetales</b>			
<i>Taphrina communis</i>	plum pockets	Protomycetaceae	CK
<i>Taphrina deformans</i>	peach leaf curl	Protomycetaceae	CK
<b>CLASS LOCULOASCOMYCETES (rots &amp; scabs)</b>			
<b>Order Myriangiales</b>			
<i>Elsinoë corni</i>	dogwood anthracnose	Elsinoëaceae	CK
<b>Order Dothideales</b>			
<i>Botryosphaeria dothidea</i>	white apple rot	Dothioraceae	CK
<i>Botryosphaeria obtusa</i>	black apple rot	Dothioraceae	CK
dothidean spp.	pear sooty molds	Dothideaceae	CK
<i>Mycosphaerella fragariae</i>	strawberry leaf spot	Dothideaceae	CK
<i>Plowrightia morbosa</i>	rot	Dothideaceae	RE

	Common Name	Family	Location
<b>Order Pleosporales</b>			
<i>Apiosporina morbosa</i>	black knot	Venturiaceae	CK
<i>Venturia crataegi</i>	apple scab	Venturiaceae	CK
<i>Venturia pyrina</i>	pear scab	Venturiaceae	CK
<b>CLASS PLECTOMYCETES (asc molds)</b>			
<b>Order Eurotiales</b>			
<i>Aspergillus herbariorum</i>	mold	Trichocomaceae	RE
<i>Aspergillus niger</i>	mold	Trichocomaceae	RE
<i>Ophiostoma ulmi</i>	Dutch elm disease	Ophiostomataceae	CK
<i>Penicillium crustaceum</i>	mold	Trichocomaceae	RE
<i>Penicillium</i> sp.	blue mold	Trichocomaceae	CK
<b>CLASS PYRENOMYCETES (flask fungi)</b>			
<b>Order Erysiphales (powdery mildews)</b>			
<i>Erysiphe cichoracearum</i>	powdery mildew	Erysiphaceae	RE
<i>Erysiphe communis</i>	powdery mildew	Erysiphaceae	RE
<i>Erysiphe montagnei</i>	powdery mildew	Erysiphaceae	RE
<i>Erysiphe polygoni</i>	black locust powdery mildew	Erysiphaceae	RE
<i>Microsphaera alni</i>	lilac powdery mildew	Erysiphaceae	CK,RE
<i>Microsphaera diffusa</i>	powdery mildew	Erysiphaceae	RE
<i>Microsphaera ravenellii</i>	powdery mildew	Erysiphaceae	RE
<i>Microsphaera viburni</i>	powdery mildew	Erysiphaceae	CK
<i>Phyllactinia corylea</i>	tree powdery mildew	Erysiphaceae	RE
<i>Podosphaera leucotricha</i>	apple powdery mildew	Erysiphaceae	CK
<i>Podosphaera oxycanthae</i>	powdery mildew	Erysiphaceae	RE
<i>Sphaerotheca castagnei</i>	downy mildew	Erysiphaceae	RE
<i>Uncinula necator</i>	grape powdery mildew	Erysiphaceae	CK
<b>Order Xylariales (flask fungi)</b>			
<i>Daldinia cingulata</i>	zoned black fungus	Xylariaceae	RE
<i>Hypoxylon</i> sp.	wood-wart	Xylariaceae	RE
<i>Xylaria digitata</i>	finger fungus	Xylariaceae	RE
<i>Xylaria polymorpha</i>	dead man's fingers	Xylariaceae	RE
<b>Order Diaporthales (flask fungi)</b>			
<i>Apiognomonina veneta</i>	sycamore anthracnose	Diaporthaceae	CK
<i>Cryphonectria parasitica</i>	chestnut blight	Diaporthaceae	CK
<i>Diaporthe ailanthi</i>	flask fungus	Diaporthaceae	RE
<i>Glomerella cingulata</i>	apple bitter rot	Diaporthaceae	CK
<i>Guignardia bidwellii</i>	grape black rot	Diaporthaceae	CK,RE
<b>Order Hypocreales</b>			
<i>Leucostoma</i> sp.	peach canker	Hypocreaceae	CK
<i>Nectria galligena</i>	nectria canker	Hypocreaceae	CK
<b>Order Clavicipitales (flask fungi)</b>			
<i>Claviceps purpurea</i>	ergot claviceps	Clavicipitaceae	RE
<i>Cordyceps militaris</i>	military orange caterpillar fungus	Clavicipitaceae	RE
<b>CLASS DISCOMYCETES (disc fungi)</b>			
<b>Order Phacidiales</b>			
<i>Rhytisma</i> sp.	maple tar spot	Rhytismataceae	CK
<b>Order Helotiales (earth tongues)</b>			
<i>Blumeriella jaapii</i>	cherry leaf spot	Dermateaceae	CK
<i>Monilinia fructicola</i>	stone fruits brown rot	Sclerotiniaceae	CK
<i>Pseudopeziza medicaginis</i>	leaf spot	Dermateaceae	RE
<i>Sclerotinia fructigena</i>	rind rot	Sclerotiniaceae	ES
<b>Order Pezizales (cup fungi and allies)</b>			
<i>Aleuria aurantia</i>	orange peel fungus	Aleuriaceae	CK
<i>Lachnea scutellata</i>	patella	Pezizaceae	RE
<i>Macropodia semitosta</i>	paxina	Pezizaceae	RE

Order Pezizales (cont'd)	Common Name	Family	Location
<i>Morchella esculenta</i>	common morel	Morchellaceae	CK
<i>Patella setosa</i>	cup fungus	Pezizaceae	CK
<b>DIVISION BASIDIOMYCOTA (basidiomycetes or small base fungi)</b>			
<b>CLASS TELIOMYCETES (rust and smut fungi)</b>			
<b>Order Uredinales (rust fungi)</b>			
<i>Aecidium cimicifugatum</i>	rust	Pucciniaceae	RE
<i>Aecidium compositatum</i>	rust	Pucciniaceae	RE
<i>Aecidium fraxini</i>	rust	Pucciniaceae	RE
<i>Aecidium grossulariae</i>	rust	Pucciniaceae	RE
<i>Aecidium impatientis</i>	rust	Pucciniaceae	RE
<i>Aecidium nesaeae</i>	rust	Pucciniaceae	RE
<i>Aecidium oenotherae</i>	rust	Pucciniaceae	RE
<i>Aecidium pammelii</i>	rust	Pucciniaceae	RE
<i>Aecidium pustulatum</i>	rust	Pucciniaceae	RE
<i>Allodus podophylli</i>	May-apple rust	Pucciniaceae	CK
<i>Coleosporium sonchi-arvensis</i>	rust	Melampsoraceae	RE
<i>Gymnoconia peckiana</i>	rust	Pucciniaceae	RE
<i>Gymnoconia</i> sp.	orange rust	Pucciniaceae	CK
<i>Gymnosporangium globosum</i>	rust	Pucciniaceae	RE
<i>Gymnosporangium juniperi-virginianae</i>	cedar-apple rust	Pucciniaceae	CK
<i>Gymnosporangium nidus-avis</i>	rust	Pucciniaceae	RE
<i>Kunkelia nitens</i>	blackberry rust	Pucciniaceae	CK
<i>Melampsora salicis-capreae</i>	melampsora rust	Melampsoraceae	RE
<i>Negrado caladii</i>	Jack in the pulpit rust	Pucciniaceae	CK
<i>Phragmidium obtusum</i>	rust	Pucciniaceae	RE
<i>Puccinia caricis</i>	current rust	Pucciniaceae	RE
<i>Puccinia coronata</i>	buckthorn crown rust	Pucciniaceae	RE
<i>Puccinia fraxinata</i>	rust	Pucciniaceae	RE
<i>Puccinia glechomatis</i>	rust	Pucciniaceae	RE
<i>Puccinia graminis</i>	grape rust	Pucciniaceae	RE
<i>Puccinia helianthi</i>	rust	Pucciniaceae	RE
<i>Puccinia malvacearum</i>	rust	Pucciniaceae	RE
<i>Puccinia menthae</i>	rust	Pucciniaceae	RE
<i>Puccinia osmorhizae</i>	rust	Pucciniaceae	RE
<i>Puccinia podophylli</i>	rust	Pucciniaceae	RE
<i>Puccinia polygoni-amphibii</i>	rust	Pucciniaceae	RE
<i>Puccinia seymeriae</i>	rust	Pucciniaceae	RE
<i>Puccinia simplex</i>	rust	Pucciniaceae	RE
<i>Puccinia taraxaci</i>	rust	Pucciniaceae	RE
<i>Puccinia xanthii</i>	rust	Pucciniaceae	RE
<i>Pucciniastrum agrimoniae</i>	rust	Pucciniastraceae	RE
<i>Uromyces euphorbiae</i>	rust	Pucciniaceae	RE
<i>Uromyces phaseoli</i>	rust	Pucciniaceae	RE
<i>Uromyces striatus</i>	rust	Pucciniaceae	RE
<i>Uromyces toxicodendri</i>	rust	Pucciniaceae	RE
<i>Uromyces trifolii</i>	rust	Pucciniaceae	RE
<b>Order Ustilaginales (smut fungi)</b>			
<i>Entyloma menispermi</i>	smut	Tilletiaceae	RE
<i>Ustilago avenae</i>	smut	Ustilaginaceae	RE
<i>Ustilago hordei</i>	smut	Ustilaginaceae	RE
<i>Ustilago maydis</i>	corn smut	Ustilaginaceae	CK
<i>Ustilago zeae</i>	smut	Ustilaginaceae	CK,RE
<b>CLASS PHRAGMOBASIDIOMYCETES (jelly and waxy fungi)</b>			
<b>Order Eutremellales (jelly fungi)</b>			
<i>Exidia spiculosa</i>	jelly fungus	Tremellaceae	CK
<i>Tremella candida</i>	jelly fungus	Tremellaceae	RE



Order Metatremellales (waxy fungi)	Common Name	Family	Location
<i>Calocera cornea</i>	clublike tuning fork	Dacrymycetaceae	RE
<b>CLASS HYMENOMYCETES (exposed hymenium fungi)</b>			
<b>Order Agaricales (coral and pore fungi)</b>			
<i>Agaricus campestris</i>	meadow mushroom	Agaricaceae	CK
<i>Agaricus comtulus</i>	agaricus	Agaricaceae	RE
<i>Amanita phalloides</i>	death cup	Amanitaceae	RE
<i>Amanitopsis vaginata</i>	sheathed amanitopsis	Amanitaceae	RE
<i>Armillaria mellea</i>	honey mushroom	Agaricaceae	CK
<i>Atrichum undulatum</i>	wavy Catherinea mushroom	Polyporaceae	CK
<i>Bjerkandera adusta</i>	pore fungus	Polyporaceae	CK
<i>Boletus chrysenteron</i>	golden-flesh or red-crack bolete	Boletaceae	RE
<i>Boletus piperatus</i>	edible bolete	Boletaceae	RE
<i>Clavaria flaccida</i>	soft coral fungus	Clavariaceae	RE
<i>Clavaria pyxidata</i>	edible coral fungus	Clavariaceae	RE
<i>Clavaria</i> sp.	coral mushroom	Clavariaceae	CK
<i>Clitocybe infundibuliformis-membranacea</i>	funnel clitocybe	Tricholomataceae	RE
<i>Clitopilus abortivus</i>	field type mushroom	Agaricaceae	CK
<i>Collybia delicatella</i>	collybia	Tricholomataceae	RE
<i>Collybia dryophila</i>	oak-loving collybia	Tricholomataceae	RE
<i>Collybia myriadophylla</i>	conifer collybia	Tricholomataceae	RE
<i>Collybia platyphylla</i>	broad-gilled collybia	Tricholomataceae	RE
<i>Coprinus fuscescens</i>	ink-cup	Coprinaceae	RE
<i>Coprinus micaceus</i>	glistening ink-cup	Coprinaceae	RE
<i>Crepidotus malachius</i>	spotted stumpfoot	Agaricaceae	CK
<i>Daedalea confragosa</i>	currycomb bracket fungus	Polyporaceae	CK
<i>Daedalea quercina</i>	oak mazegill fungus	Polyporaceae	CK
<i>Entoloma</i> sp.	entoloma	Rhodophyllaceae	RE
<i>Favolus alveolaris</i>	pore fungus	Polyporaceae	CK
<i>Fomes applanatus</i>	artist's fomes	Polyporaceae	RE
<i>Fomes everhartii</i>	artist's type fungus	Polyporaceae	CK
<i>Fomes ohioensis</i>	artist's type fungus	Polyporaceae	CK
<i>Galera</i> sp.	deadly galerina	Cortinariaceae	RE
<i>Ganoderma applanatum</i>	artist's shelf fungus	Polyporaceae	CK
<i>Gomphidius</i> sp.	gomphidius	Gomphidiaceae	RE
<i>Gyrodrom merulioides</i>	fleshy pore fungus or bolete	Boletaceae	CK
<i>Hydrochaete olivacea</i>	red leather fungus	Polyporaceae	CK,RE
<i>Inocybe</i> sp.	fiber cap	Cortinariaceae	RE
<i>Irpex lacteus</i>	white leather fungus	Polyporaceae	RE
<i>Lactarius rimosellus</i>	milk cap	Russulaceae	RE
<i>Lactarius subdulcis</i>	dull milk cap	Russulaceae	RE
<i>Lactarius theiogalus</i>	yellow -straining milk cap	Russulaceae	RE
<i>Laetiporus sulphureus</i>	sulfur polypore	Polyporaceae	RE
<i>Lentinus sulcatus</i>	lentinus	Tricholomataceae	RE
<i>Lenzites betulina</i>	birch mazegill fungus	Polyporaceae	CK
<i>Lenzites sepiaria</i>	gill polypore	Polyporaceae	RE
<i>Lepiota adirondackensis</i>	Adirondacks lepiota	Lepiotaceae	RE
<i>Lepiota cristata</i>	crested lepiota	Lepiotaceae	RE
<i>Lepiota erminea</i>	ermine lepiota	Lepiotaceae	RE
<i>Lepiota illinita</i>	lepiota	Lepiotaceae	RE
<i>Macrolepiota procera</i>	parasol mushroom	Lepiotaceae	CK
<i>Marasmius albiceps</i>	marasmius	Tricholomataceae	RE
<i>Marasmius candidus</i>	marasmius	Tricholomataceae	RE
<i>Marasmius nigripes</i>	marasmius	Tricholomataceae	RE
<i>Marasmius oreades</i>	fairy-ring mushroom	Tricholomataceae	CK
<i>Marasmius siccus</i>	orange pin-wheel	Tricholomataceae	RE
<i>Marasmius trullisatipes</i>	marasmius	Tricholomataceae	RE
<i>Mycena capillaris</i>	bonnet mushroom	Tricholomataceae	RE
<i>Oligoporus tephroleucus</i>	pore fungus	Polyporaceae	CK
<i>Panus rudis</i>	rudy panus	Amanitaceae	RE

Order Agaricales (cont'd)	Common Name	Family	Location
<i>Panus strypticus</i>	field type mushroom	Amanitaceae	CK
<i>Phaeolus schweinitzii</i>	polypore	Polyporaceae	RE
<i>Phellinus gilvus</i>	polypore	Polyporaceae	CK,RE
<i>Pholiota unicolor</i>	scapecap mushroom	Cortinariaceae	CK
<i>Pleurotus sapidus</i>	lavender-spored pleurotus	Tricholomataceae	CK,RE
<i>Pluteus cervinus</i>	fawn-colored pluteus	Vovlariaceae	RE
<i>Polyporus arcularius</i>	polypore	Polyporaceae	CK,RE
<i>Polyporus carneus</i>	polypore	Polyporaceae	RE
<i>Polyporus elegans</i>	pore fungus	Polyporaceae	CK
<i>Polyporus squamosus</i>	Dryad's saddle fungus	Polyporaceae	CK
<i>Polystictus hirsutus-albiporus</i>	polypore	Polyporaceae	RE
<i>Poria unita</i>	pore fungus	Polyporaceae	CK
<i>Psilocybe ammophila</i>	psilocybe	Cortinariaceae	RE
<i>Pyenoporus cinnabarinus</i>	cinnabar polypore	Polyporaceae	RE
<i>Russula alutacea</i>	red brittle gills	Russulaceae	RE
<i>Russula compacta</i>	compact brittle gills	Russulaceae	RE
<i>Russula ftens</i>	fetid brittle gills	Russulaceae	RE
<i>Russula pectinata</i>	brittle gills	Russulaceae	RE
<i>Russula xerampelina</i>	crab-scented brittle gills	Russulaceae	RE
<i>Schizophyllum commune</i>	spit-gilled bracket	Schizophyllaceae	RE
<i>Steccherinum ochraceum</i>	hydnum tooth fungus	Hydnaceae	CK
<i>Stereum candidum</i>	sereum	Corticiaceae	RE
<i>Stereum disciforme</i>	sereum	Corticiaceae	RE
<i>Stereum fasciatum</i>	sereum	Corticiaceae	RE
<i>Stereum frustulosum</i>	false turkeytail fungus	Corticiaceae	CK
<i>Stereum versicolor</i>	sereum	Corticiaceae	RE
<i>Strobilomyces strobilaceus</i>	old-man-of-the-woods	Boletaceae	RE
<i>Trametes conchifer</i>	pore fungus	Polyporaceae	CK
<i>Trametes versicolor</i>	turkeytail or pore fungus	Polyporaceae	CK
<i>Tricholoma albo-flavidum</i>	knight-cap	Tricholomataceae	RE
<b>CLASS GASTEROMYCETES (stomach fungi)</b>			
<b>Order Phallales</b>			
<i>Mutinus caninus</i>	dog stinkhorn	Phallaceae	CK
<b>Order Lycoperdales (puffballs)</b>			
<i>Bovista pila</i>	common puffball	Lycoperdaceae	CK
<i>Calvatia gigantea</i>	giant puffball	Lycoperdaceae	CK
<i>Geaster hygrometricus</i>	water measuring earthstar	Lycoperdaceae	RE
<i>Lycoperdon perlatum</i>	gem puffball	Lycoperdaceae	CK
<i>Lycoperdon pusillum</i>	mini puffball	Lycoperdaceae	CK,RE
<i>Lycoperdon pyriforme</i>	pear-shaped or stump puffball	Lycoperdaceae	CK,RE
<i>Myriostoma coliformis</i>	pepper box	Lycoperdaceae	RE
<b>Order Tulostomatales (stalked puffballs)</b>			
<i>Tulostoma campestre</i>	field tylostoma	Tulostomataceae	RE
<i>Tulostoma fimbriatum</i>	buried-stalk puffball	Tulostomataceae	RE
<b>Order Sclerodermatales</b>			
<i>Scleroderma citrinum</i>	common earth ball	Sclerodermataceae	CK
<b>Order Nidulariales (bird's-nest fungi)</b>			
<i>Cyathus striatus</i>	fluted bird's nest	Nidulariaceae	RE
<b>DIVISION DEUTEROMYCOTA</b>			
<b>(second or imperfect fungi)</b>			
<b>CLASS HYPOMYCETES</b>			
<b>Order Hyphomycetales</b>			
<i>Botrytis cinerea</i>	raspberry mold	Moniliaceae	CK
<i>Cercospora chenopodii</i>	imperfect fungus	Dematiaceae	RE
<i>Cercospora clavata</i>	imperfect fungus	Dematiaceae	RE
<i>Cercospora helianthi</i>	imperfect fungus	Dematiaceae	RE

Order Hyphomycetales(cont'd)	Common Name	Family	Location
<i>Cercospora maianthemii</i>	imperfect fungus	Dematiaceae	RE
<i>Cercospora monoica</i>	imperfect fungus	Dematiaceae	RE
<i>Cercospora osmorhizæ</i>	imperfect fungus	Dematiaceae	RE
<i>Cercospora oxybaphi</i>	imperfect fungus	Dematiaceae	RE
<i>Cercospora tuberosa</i>	imperfect fungus	Dematiaceae	RE
<i>Cladosporium carpophilum</i>	peach scab	Moniliaceae	CK
<i>Didymaria ungeri</i>	imperfect fungus	Moniliaceae	RE
<i>Drechslera teres</i>	imperfect fungus	Dematiaceae	RE
<i>Macrosporium saponariæ</i>	imperfect fungus	Dematiaceae	RE
<i>Macrosporium solani</i>	imperfect fungus	Dematiaceae	RE
<i>Ovularia obliqua</i>	imperfect fungus	Moniliaceae	RE
<i>Ramularia arvensis</i>	imperfect fungus	Moniliaceae	RE
<i>Ramularia celastiri</i>	imperfect fungus	Moniliaceae	RE
<i>Ramularia variabilis</i>	imperfect fungus	Moniliaceae	RE
<i>Rhinotrichum curtisii</i>	imperfect fungus	Moniliaceae	RE
<b>Order Tuberculariales</b>			
<i>Tuberculina persicina</i>	imperfect fungus	Tuberculariaceae	RE
<b>CLASS COELOMYCETES</b>			
<b>Order Melanconiales</b>			
<i>Cylindrosporium padi</i>	imperfect fungus	Melanconiaceae	RE
<i>Gleosporium irregulare</i>	imperfect fungus	Melanconiaceae	RE
<i>Gleosporium nervisequum</i>	imperfect fungus	Melanconiaceae	RE
<i>Gleosporium septorioides</i>	imperfect fungus	Melanconiaceae	RE
<i>Marsonia toxicodendri</i>	imperfect fungus	Melanconiaceae	RE
<b>Order Sphaeropsidales</b>			
<i>Cicinnobolus cesatii</i>	imperfect fungus	Sphaeropsidaceae	RE
<i>Coniothyrium</i> sp.	raspberry cane blight	Sphaeropsidaceae	CK
<i>Diplodia maydis</i>	corn ear rot	Sphaeropsidaceae	CK
<i>Peltaster fructicola</i>	apple sooty blotch mold	Leptostromataceae	CK
<i>Phoma uvicola</i>	imperfect fungus	Sphaeropsidaceae	RE
<i>Phyllosticta cruenta</i>	imperfect fungus	Sphaeropsidaceae	RE
<i>Phyllosticta iridis</i>	imperfect fungus	Sphaeropsidaceae	RE
<i>Phyllosticta palustris</i>	imperfect fungus	Sphaeropsidaceae	RE
<i>Phyllosticta phaseolina</i>	imperfect fungus	Sphaeropsidaceae	RE
<i>Septoria ægopodii</i>	imperfect fungus	Sphaeropsidaceae	RE
<i>Septoria aquilegiæ</i>	imperfect fungus	Sphaeropsidaceae	RE
<i>Septoria erigerontis</i>	imperfect fungus	Sphaeropsidaceae	RE
<i>Septoria lactucicola</i>	imperfect fungus	Sphaeropsidaceae	RE
<i>Septoria littorea</i>	imperfect fungus	Sphaeropsidaceae	RE
<i>Septoria lophanthi</i>	imperfect fungus	Sphaeropsidaceae	RE
<i>Septoria musiva</i>	imperfect fungus	Sphaeropsidaceae	RE
<i>Septoria ochroleuca</i>	imperfect fungus	Sphaeropsidaceae	RE
<i>Septoria oenotheræ</i>	imperfect fungus	Sphaeropsidaceae	RE
<i>Septoria podophyllina</i>	imperfect fungus	Sphaeropsidaceae	RE
<i>Septoria polygonorum</i>	imperfect fungus	Sphaeropsidaceae	RE
<i>Septoria rubi</i>	imperfect fungus	Sphaeropsidaceae	RE
<i>Septoria scrophulariæ</i>	imperfect fungus	Sphaeropsidaceae	RE
<i>Septoria violæ-palustris</i>	imperfect fungus	Sphaeropsidaceae	RE
<i>Zygothiala jamaicensis</i>	apple flyspeck	Leptostromataceae	CK
<b>DIVISION MYCOPHYCOPHYTA</b>			
<b>(lichens or fungus algae)</b>			
<b>CLASS ASCOLICHENES (ascomycote lichens)</b>			
<b>Order Pyrenulales</b>			
<i>Arthopyrenia alba</i>	lichen	Pyrenulaceae	RE
<i>Microthelia micula</i>	lichen	Pyrenulaceae	RE
<i>Pyrenula leucoplaca</i>	lichen	Pyrenulaceae	RE
<i>Trypethelium virens</i>	lichen	Trypetheliaceae	RE
<i>Verrucaria muralis</i>	pitted lichen	Verrucariaceae	RE

Order	Common Name	Family	Location
<b>Order Caliciales</b>			
<i>Coniocybe furfuracea</i>	lichen	Caliciaceae	RE
<b>Order Hysteriales</b>			
<i>Arthonia punctiformis</i>	lichen	Arthoniaceae	RE
<i>Arthonia radiata</i>	lichen	Arthoniaceae	RE
<i>Arthothelium spectabile</i>	lichen	Arthoniaceae	RE
<i>Graphis scripta</i>	script lichen	Graphidaceae	RE
<i>Opegrapha lichenoides</i>	lichen	Graphidaceae	RE
<i>Opegrapha pulicaris</i>	lichen	Graphidaceae	RE
<i>Opegrapha viridis</i>	lichen	Graphidaceae	RE
<b>Order Lecanorales</b>			
<i>Alectoria nidulifera</i>	lichen	Usneaceae	RE
<i>Anaptychia echinata</i>	lichen	Physciaceae	RE
<i>Anaptychia hypoleuca</i>	lichen	Physciaceae	RE
<i>Anaptychia leucomelaena</i>	lichen	Physciaceae	RE
<i>Anaptychia palmulata</i>	lichen	Physciaceae	RE
<i>Anaptychia speciosa</i>	lichen	Physciaceae	RE
<i>Bacidia fusciorubella</i>	lichen	Lecideaceae	RE
<i>Bacidia schweinitzii</i>	lichen	Lecideaceae	RE
<i>Bilimbia sabuletorum</i>	lichen	Lecideaceae	RE
<i>Bilimbia trachona</i>	lichen	Lecideaceae	RE
<i>Buellia parasema</i>	lichen	Buelliaceae	RE
<i>Caloplaca aurantiaca</i>	lichen	Caloplacaceae	RE
<i>Caloplaca cerina</i>	lichen	Caloplacaceae	RE
<i>Candelaria concolor</i>	lichen	Parmeliaceae	RE
<i>Candelaria fibrosa</i>	lichen	Parmeliaceae	RE
<i>Cetraria ciliaris</i>	shield lichen	Parmeliaceae	RE
<i>Cetraria ericetorum</i>	shield lichen	Parmeliaceae	RE
<i>Cladonia arbuscula</i>	lichen	Cladoniaceae	RE
<i>Cladonia bacillaris</i>	lichen	Cladoniaceae	RE
<i>Cladonia caespiticia</i>	lichen	Cladoniaceae	RE
<i>Cladonia capitata</i>	lichen	Cladoniaceae	RE
<i>Cladonia coniocraea</i>	lichen	Cladoniaceae	RE
<i>Cladonia conista</i>	lichen	Cladoniaceae	RE
<i>Cladonia cristatella</i>	British soldiers or red crest lichen	Cladoniaceae	RE
<i>Cladonia cryptochlorophaea</i>	lichen	Cladoniaceae	RE
<i>Cladonia fimbriata</i>	lichen	Cladoniaceae	RE
<i>Cladonia furcata</i>	lichen	Cladoniaceae	RE
<i>Cladonia gracilis</i>	spoon lichen	Cladoniaceae	RE
<i>Cladonia grayi</i>	lichen	Cladoniaceae	RE
<i>Cladonia nemoxya</i>	lichen	Cladoniaceae	RE
<i>Cladonia parasitica</i>	lichen	Cladoniaceae	RE
<i>Cladonia pyxidata</i>	pixie cup lichen	Cladoniaceae	RE
<i>Cladonia rangiferina</i>	reindeer lichen	Cladoniaceae	RE
<i>Cladonia</i> sp.	reindeer moss	Cladoniaceae	CK
<i>Cladonia squamosa</i>	lichen	Cladoniaceae	RE
<i>Cladonia subcariosa</i>	lichen	Cladoniaceae	RE
<i>Cladonia verticillata</i>	ladder lichen	Cladoniaceae	RE
<i>Collema subfurvum</i>	lichen	Collemaceae	RE
<i>Conotrema urceolatum</i>	lichen	Diploschistaceae	RE
<i>Lecanora dispersa</i>	lichen	Lecanoraceae	RE
<i>Lecanora pallida</i>	lichen	Lecanoraceae	RE
<i>Lecanora subfusca</i>	lichen	Lecanoraceae	RE
<i>Lecanora varia</i>	lichen	Lecanoraceae	RE
<i>Lecidea albocaerulescens</i>	whitewash lichen	Lecideaceae	RE
<i>Lecidea myriocarpoides</i>	whitewash lichen	Lecideaceae	RE
<i>Lecidea parasema</i>	whitewash lichen	Lecideaceae	RE
<i>Lecidea viridescens</i>	whitewash lichen	Lecideaceae	RE
<i>Lepraria</i> sp.	lichen	Leprariaceae	RE

Order Lecanorales (cont'd)	Common Name	Family	Location
<i>Leptogium lichenoides</i>	lichen	Collemaceae	RE
<i>Leptogium tenuissimum</i>	lichen	Collemaceae	RE
<i>Leptogium tremelloides</i>	lichen	Collemaceae	RE
<i>Ochrolechia tartarea</i>	lichen	Lecanoraceae	RE
<i>Parmelia aspera</i>	boulder lichen	Parmeliaceae	RE
<i>Parmelia aurulenta</i>	boulder lichen	Parmeliaceae	RE
<i>Parmelia borreri</i>	boulder lichen	Parmeliaceae	RE
<i>Parmelia caperata</i>	boulder lichen	Parmeliaceae	RE
<i>Parmelia crozalsiana</i>	boulder lichen	Parmeliaceae	RE
<i>Parmelia flaventior</i>	boulder lichen	Parmeliaceae	RE
<i>Parmelia livida</i>	boulder lichen	Parmeliaceae	RE
<i>Parmelia margaritata</i>	boulder lichen	Parmeliaceae	RE
<i>Parmelia perlata</i>	boulder lichen	Parmeliaceae	RE
<i>Parmelia rudecta</i>	boulder lichen	Parmeliaceae	RE
<i>Parmelia saxatilis</i>	boulder lichen	Parmeliaceae	RE
<i>Parmelia sulcata</i>	boulder lichen	Parmeliaceae	RE
<i>Parmelia ulophyllodes</i>	boulder lichen	Parmeliaceae	RE
<i>Peltigera apthosa</i>	lichen	Peltigeraceae	RE
<i>Peltigera canina</i>	dog lichen	Peltigeraceae	RE
<i>Peltigera canina spuria</i>	lichen	Peltigeraceae	RE
<i>Peltigera horizontalis</i>	lichen	Peltigeraceae	RE
<i>Peltigera spuria</i>	lichen	Peltigeraceae	RE
<i>Pertusaria leioplaca</i>	lichen	Pertusariaceae	RE
<i>Pertusaria multipuncta</i>	lichen	Pertusariaceae	RE
<i>Pertusaria pertusa</i>	lichen	Pertusariaceae	RE
<i>Pertusaria pustulata</i>	lichen	Pertusariaceae	RE
<i>Physcia adscendens</i>	lichen	Physciaceae	RE
<i>Physcia aguila detonsa</i>	lichen	Physciaceae	RE
<i>Physcia aipolia</i>	lichen	Physciaceae	RE
<i>Physcia ciliata</i>	lichen	Physciaceae	RE
<i>Physcia elaeina</i>	lichen	Physciaceae	RE
<i>Physcia grisea</i>	lichen	Physciaceae	RE
<i>Physcia hypoleuca</i>	lichen	Physciaceae	RE
<i>Physcia millegrana</i>	lichen	Physciaceae	RE
<i>Physcia orbicularis</i>	lichen	Physciaceae	RE
<i>Physcia stellaris</i>	lichen	Physciaceae	RE
<i>Physcia syncolla</i>	lichen	Physciaceae	RE
<i>Physcia tribacia</i>	lichen	Physciaceae	RE
<i>Physcia tribacoides</i>	lichen	Physciaceae	RE
<i>Placynthium nigrum</i>	lichen	Pannariaceae	RE
<i>Ramalina farinacea</i>	lichen	Usneaceae	RE
<i>Ramalina sinensis</i>	lichen	Usneaceae	RE
<i>Rinodina tephraspis</i>	lichen	Buelliaaceae	RE
<i>Sarcogyne simplex</i>	lichen	Acarosporaceae	RE
<i>Sticta pulmonaria</i>	lichen	Stictaceae	RE
<i>Teloschistes chrysophthalmus</i>	lichen	Teloschistaceae	RE
<i>Usnea strigosa</i>	lichen	Usneaceae	RE
<i>Xanthoria candelaria</i>	lichen	Teloschistaceae	RE
<i>Xanthoria fallax</i>	lichen	Teloschistaceae	RE
<i>Xanthoria polycarpa</i>	lichen	Teloschistaceae	RE

## KINGDOM PLANTAE

## DIVISION BRYOPHYTA (mosses and liverworts)

## CLASS HEPATICOPSIDA (liverworts)

## Order Jungermanniales

*Lophocolea heterophylla*

## Common Name

liverwort

## Family

Lophocoleaceae

## Location

CK

## Order Marchantiales (typical liverworts)

*Conocephalum conicum*

common liverwort

Conocephalaceae

CK

*Riccia fluitans*

slender riccia

Ricciaceae

ES

*Ricciocarpus natans*

purple-fringed riccia

Ricciaceae

ES

## CLASS SPHAGNOPSIDA (peat mosses)

## Order Sphagnales

*Sphagnum compactum*

sphagnum

Sphagnaceae

RE

*Sphagnum lescurii*

sphagnum

Sphagnaceae

RE

*Sphagnum magellanicum*

sphagnum

Sphagnaceae

RE

*Sphagnum palustre*

boat-leaved sphagnum

Sphagnaceae

RE

*Sphagnum russowii*

sphagnum

Sphagnaceae

RE

*Sphagnum* sp.

bog moss

Sphagnaceae

CK

## CLASS BRYOPSIDA (mosses)

## Order Polytrichales

*Atrichum atecristatum*

spineleaf moss

Polytrichaceae

RE

*Atrichum angustatum*

slender Catherinea

Polytrichaceae

RE

*Atrichum undulatum*

spineleaf moss

Polytrichaceae

RE

*Pogonatum pensilvanicum*

false hair-cap moss

Polytrichaceae

RE

*Polytrichum commune*

common hair-cap moss

Polytrichaceae

CK,RE

*Polytrichum ohioense*

hair-cap moss

Polytrichaceae

CK,RE

*Polytrichum piliferum*

hair-cap moss

Polytrichaceae

RE

## Order Tetraphales

*Tetraphis pellucida*

four-tooth moss

Tetraphidaceae

RE

## Order Funariales

*Discelium nudum*

moss

Disceliaceae

RE

*Funaria hygrometrica*

cord moss

Funariaceae

CK,RE

*Physcomitrium pyriforme*

urn moss

Funariaceae

RE

## Order Orthotrichales

*Drummondia prorepens*

moss

Orthotrichaceae

RE

*Orthotrichum anomalum*

moss

Orthotrichaceae

RE

*Orthotrichum pumilum*

moss

Orthotrichaceae

RE

*Orthotrichum pusillum*

moss

Orthotrichaceae

RE

*Orthotrichum strangulatum*

moss

Orthotrichaceae

RE

*Ulota crispa*

moss

Orthotrichaceae

RE

## Order Bryales

*Aulacomnium heterostichum*

moss

Aulacomniaceae

RE

*Aulacomnium palustre*

moss

Aulacomniaceae

RE

*Bartramia pomiformis*

apple moss

Bartramiaceae

RE

*Bryum argenteum*

silvery moss

Bryaceae

RE

*Bryum caespiticium*

silvery moss

Bryaceae

RE

*Bryum capillare*

silvery moss

Bryaceae

RE

*Bryum lisae* var. *cuspidatum*

silvery moss

Bryaceae

RE

*Bryum pseudotriquetrum*

silvery moss

Bryaceae

RE

*Leptobryum pyriforme*

moss

Bryaceae

RE

*Mnium cuspidatum*

woodsly mnium moss

Mniaceae

CK

*Mnium stellare*

star moss

Mniaceae

RE

*Philonotis fontana*

moss

Bartramiaceae

RE

*Plagiomnium ciliare*

moss

Mniaceae

RE

*Plagiomnium cuspidatum*

moss

Mniaceae

RE

*Plagiomnium medium*

moss

Mniaceae

RE

*Pohlia nutans*

moss

Bryaceae

RE

Order Bryales (cont'd)	Common Name	Family	Location
<i>Rhizomnium punctatum</i>	moss	Mniaceae	RE
<i>Rhodobryum roseum</i>	rose moss	Bryaceae	RE
<b>Order Hypnobryales</b>			
<i>Amblystegium serpens</i>	moss	Amblystegiaceae	RE
<i>Amblystegium serpens</i> var. <i>juratzkanum</i>	moss	Amblystegiaceae	RE
<i>Amblystegium varium</i>	moss	Amblystegiaceae	CK,RE
<i>Brachythecium acuminatum</i>	moss	Brachytheciaceae	RE
<i>Brachythecium campestre</i>	moss	Brachytheciaceae	RE
<i>Brachythecium oxycladon</i>	moss	Brachytheciaceae	RE
<i>Brachythecium rivulare</i>	rivulet brachythecium	Brachytheciaceae	RE
<i>Brachythecium rutabulum</i>	moss	Brachytheciaceae	RE
<i>Brachythecium salebrosum</i>	moss	Brachytheciaceae	RE
<i>Bryhnia graminicolor</i>	moss	Brachytheciaceae	RE
<i>Bryhnia novae-angliae</i>	moss	Brachytheciaceae	RE
<i>Bryoandersonia illecebra</i>	moss	Brachytheciaceae	RE
<i>Callicladium haldanianum</i>	moss	Hypnaceae	RE
<i>Calliergon stramineum</i>	moss	Amblystegiaceae	RE
<i>Calliergon trifarium</i>	moss	Amblystegiaceae	RE
<i>Calliergonella cuspidata</i>	moss	Amblystegiaceae	RE
<i>Campylium chrysophyllum</i>	moss	Amblystegiaceae	RE
<i>Campylium hispidulum</i>	moss	Amblystegiaceae	RE
<i>Campylium polygamum</i>	moss	Amblystegiaceae	RE
<i>Campylium stellatum</i>	moss	Amblystegiaceae	RE
<i>Cyrto-hypnum minutulum</i>	moss	Thuidiaceae	RE
<i>Drepanocladus aduncus</i> var. <i>aduncus</i>	moss	Amblystegiaceae	RE
<i>Drepanocladus aduncus</i> var. <i>kneiffii</i>	moss	Amblystegiaceae	RE
<i>Entodon cladorrhizans</i>	moss	Entodontaceae	RE
<i>Entodon seductrix</i>	moss	Entodontaceae	RE
<i>Eurhynchium hians</i>	moss	Brachytheciaceae	RE
<i>Eurhynchium pulchellum</i>	moss	Brachytheciaceae	RE
<i>Eurhynchium serrulatum</i>	moss	Brachytheciaceae	CK
<i>Helodium blandowii</i>	moss	Thuidiaceae	RE
<i>Helodium paludosum</i>	moss	Thuidiaceae	RE
<i>Herzogiella turfacea</i>	moss	Hypnaceae	RE
<i>Homomallium adnatum</i>	moss	Hypnaceae	RE
<i>Hygroamblystegium fluviatile</i>	moss	Amblystegiaceae	RE
<i>Hygroamblystegium tenax</i>	moss	Amblystegiaceae	RE
<i>Hygrohypnum luridum</i>	moss	Amblystegiaceae	RE
<i>Hypnum cupressiforme</i>	moss	Hypnaceae	RE
<i>Hypnum curvifolium</i>	feather moss	Hypnaceae	CK,RE
<i>Hypnum imponens</i>	moss	Hypnaceae	RE
<i>Hypnum lindbergii</i>	moss	Hypnaceae	RE
<i>Isopterygiopsis muelleriana</i>	moss	Hypnaceae	RE
<i>Leptodictyum humile</i>	moss	Amblystegiaceae	RE
<i>Leptodictyum riparium</i>	moss	Amblystegiaceae	RE
<i>Limprichtia revolvens</i>	moss	Amblystegiaceae	RE
<i>Plagiothecium cavifolium</i>	slender moss	Plagiotheciaceae	RE
<i>Plagiothecium denticulatum</i>	slender moss	Plagiotheciaceae	RE
<i>Plagiothecium</i> sp.	moss	Plagiotheciaceae	CK
<i>Platydictya confervoides</i>	moss	Hypnaceae	RE
<i>Platygyrium repens</i>	moss	Hypnaceae	RE
<i>Pleurozium schreberi</i>	moss	Hylocomiaceae	RE
<i>Pylaisiella intricata</i>	moss	Hypnaceae	RE
<i>Pylaisiella selwynii</i>	moss	Hypnaceae	RE
<i>Rauia scita</i>	moss	Thuidiaceae	RE
<i>Rhytidium rugosum</i>	moss	Rhytidiaceae	RE
<i>Sematophyllum demissum</i>	moss	Sematophyllaceae	RE
<i>Stereocleus serrulatus</i>	moss	Brachytheciaceae	RE
<i>Taxiphyllum taxirameum</i>	moss	Hypnaceae	RE

Order	Common Name	Family	Location
<b>Order Hypnobryales (cont'd)</b>			
<i>Thuidium delicatulum</i>	common fern moss	Thuidiaceae	CK,RE
<i>Thuidium recognitum</i>	fern moss	Thuidiaceae	RE
<b>Order Isobryales</b>			
<i>Anacamptodon splachnoides</i>	moss	Fabroniaceae	RE
<i>Anomodon attenuatus</i>	moss	Leskeaceae	RE
<i>Anomodon minor</i>	moss	Leskeaceae	RE
<i>Anomodon rostratus</i>	moss	Leskeaceae	RE
<i>Anomodon rugelii</i>	moss	Leskeaceae	RE
<i>Climacium americanum</i>	tree moss	Climaciaceae	CK,RE
<i>Climacium kindbergii</i>	tree-flooded moss	Climaciaceae	CK,RE
<i>Fontinalis dalecarlica</i>	common water moss	Fontinaliaceae	RE
<i>Fontinalis hypnoides</i>	water moss	Fontinaliaceae	RE
<i>Fontinalis hypnoides</i> var. <i>duriaei</i>	water moss	Fontinaliaceae	RE
<i>Hedwigia ciliata</i>	white-tipped moss	Hedwigiaceae	RE
<i>Leskea gracilescens</i>	moss	Leskeaceae	RE
<i>Leskea obscura</i>	moss	Leskeaceae	RE
<i>Leucodon julaceus</i>	moss	Leucodontaceae	RE
<i>Thelia asprella</i>	moss	Leskeaceae	RE
<i>Thelia hirtella</i>	moss	Leskeaceae	RE
<b>Order Pottiales</b>			
<i>Barbula convoluta</i>	moss	Pottiaceae	RE
<i>Barbula indica</i> var. <i>indica</i>	twisted teeth moss	Pottiaceae	RE
<i>Barbula unguiculata</i>	moss	Pottiaceae	RE
<i>Bryoerythrophyllum recurvirostre</i>	moss	Pottiaceae	RE
<i>Desmatodon obtusifolius</i>	moss	Pottiaceae	RE
<i>Desmatodon porteri</i>	moss	Pottiaceae	RE
<i>Didymodon fallax</i>	moss	Pottiaceae	RE
<i>Didymodon rigidulus</i>	moss	Pottiaceae	RE
<i>Gymnostomum aeruginosum</i>	moss	Pottiaceae	RE
<i>Hymenostylium recurvirostre</i>	moss	Pottiaceae	RE
<i>Hyophila involuta</i>	moss	Pottiaceae	RE
<i>Phascum cuspidatum</i>	moss	Pottiaceae	RE
<i>Tortella humilis</i>	twisted moss	Pottiaceae	RE
<i>Tortella tortuosa</i>	twisted moss	Pottiaceae	RE
<i>Tortula ruralis</i>	wall moss	Pottiaceae	RE
<i>Weissia controversa</i>	moss	Pottiaceae	RE
<b>Order Dicranales</b>			
<i>Bruchia flexuosa</i>	moss	Ditrichaceae	RE
<i>Ceratodon purpureus</i>	purple horn-tooth moss	Ditrichaceae	RE
<i>Dicranella cerviculata</i>	fork moss	Dicranaceae	RE
<i>Dicranella heteromalla</i>	silky fork moss	Dicranaceae	RE
<i>Dicranella varia</i>	fork moss	Dicranaceae	RE
<i>Dicranum flagellare</i>	broom moss	Dicranaceae	RE
<i>Dicranum scoparium</i>	broom moss	Dicranaceae	RE
<i>Dicranum viride</i>	broom moss	Dicranaceae	RE
<i>Ditrichum lineare</i>	moss	Ditrichaceae	RE
<i>Leucobryum glaucum</i>	white pin-cushion moss	Leucobryaceae	RE
<i>Pleuridium subulatum</i>	moss	Ditrichaceae	RE
<b>Order Fissidentales</b>			
<i>Fissidens adianthoides</i>	moss	Fissidentaceae	RE
<i>Fissidens bryoides</i>	moss	Fissidentaceae	RE
<i>Fissidens obtusifolius</i>	moss	Fissidentaceae	RE
<i>Fissidens taxifolius</i>	moss	Fissidentaceae	CK,RE
<b>Order Seligeriales</b>			
<i>Seligeria calcarea</i>	moss	Seligeriaceae	RE
<i>Seligeria campylopoda</i>	moss	Seligeriaceae	RE
<i>Seligeria pusilla</i>	moss	Seligeriaceae	RE



	Common Name	Family	Location
<b>Order Grimmiiales</b>			
<i>Grimmia pulvinata</i>	moss	Grimmiaceae	RE
<i>Schistidium apocarpum</i>	moss	Grimmiaceae	RE
<i>Schistidium rivulare</i>	moss	Grimmiaceae	RE
<b>DIVISION LYCOPODIOPHYTA (clubmosses)</b>			
<b>CLASS LYCOPODIOPSIDA (clubmosses)</b>			
<b>Order Lycopodiales</b>			
<i>Lycopodium dendroideum</i>	tree-like clubmoss	Lycopodiaceae	CK
<i>Lycopodium obscurum</i>	tree clubmoss	Lycopodiaceae	CK
<b>DIVISION EQUISETOPHYTA (horsetails and scouring rushes)</b>			
<b>CLASS EQUISETOPSIDA (horsetails)</b>			
<b>Order Equisetales</b>			
<i>Equisetum arvense</i>	field or common horsetail	Equisetaceae	CK,ES
<i>Equisetum hyemale</i>	rough horsetail, scouring rush	Equisetaceae	CK
<b>DIVISION FILICOPHYTA [=POLYPODIOPHYTA] (ferns)</b>			
<b>CLASS FILICOPSIDA [=POLYPODIOPSIDA] (ferns)</b>			
<b>Order Ophioglossales</b>			
<i>Botrychium dissectum</i>	cut-leaf grapefern	Ophioglossaceae	CK
<i>Botrychium rugulosum</i>	leathery grapefern	Ophioglossaceae	CK
<i>Botrychium virginianum</i>	rattlesnake fern	Ophioglossaceae	CK,ES
<b>Order Polypodiales</b>			
<i>Adiantum pedatum</i>	northern maidenhair fern	Adiantaceae	CK,ES
<i>Athyrium filix-femina</i>	subarctic lady fern	Aspleniaceae	CK,ES
<i>Cystopteris bulbifera</i>	bulblet fern	Aspleniaceae	CK
<i>Cystopteris tenuis</i>	fragile fern	Aspleniaceae	CK
<i>Dryopteris carthusiana</i>	spinulose woodfern	Aspleniaceae	CK,ES
<i>Dryopteris intermedia</i>	evergreen woodfern	Aspleniaceae	CK
<i>Dryopteris marginalis</i>	marginal shield-fern or woodfern	Aspleniaceae	CK
<i>Dryopteris</i> sp.	woodfern	Aspleniaceae	ES
<i>Gymnocarpium dryopteris</i>	oak-fern	Aspleniaceae	CK
<i>Onoclea sensibilis</i>	sensitive fern	Onocleaceae	CK,ES
<i>Osmunda cinnamomea</i>	cinnamon fern	Osmundaceae	ES
<i>Osmunda claytoniana</i>	fern	Osmundaceae	CK,ES
<i>Phegopteris hexagonoptera</i>	broad beech-fern	Aspleniaceae	CK
<i>Polypodium virginianum</i>	common polypody	Polypodiaceae	CK
<i>Polystichum acrostichoides</i>	Christmas fern	Aspleniaceae	CK,ES

Location Codes:

- CK – Old Woman Creek watershed upstream of the estuary
- ES – Old Woman Creek estuary (including watershed within boundaries of NERR)
- LE – Lake Erie, principally nearshore waters of Erie County and western Lorain County, Ohio
- RE – Regional occurrence, principally Lake Erie watersheds of eastern Erie County and western Lorain County, Ohio

**APPENDIX B. VASCULAR PLANTS  
OF OLD WOMAN CREEK ESTUARY AND WATERSHED**

	Common Name	Phenology	Origin	Loc
<b>LIVERWORTS (Ricciaceae)</b>				
<i>Riccia fluitans</i>	slender riccia		N	E
<i>Ricciocarpus natans</i>	purple-fringed riccia		N	E
<b>CLUBMOSES (Lycopodiaceae)</b>				
<i>Lycopodium dendroideum</i>	tree-like clubmoss		N	W
<i>Lycopodium obscurum</i>	tree clubmoss	Jul-Nov	N	W
<b>HORSETAILS (Equisetaceae)</b>				
<i>Equisetum arvense</i>	field or common horsetail	Apr-Jul	N	E,W
<i>Equisetum hyemale</i>	rough horsetail, scouring rush	Jun-Aug	N	W
<b>ADDER'S TONGUES (Ophioglossaceae)</b>				
<i>Botrychium dissectum</i>	cut-leaf grapefern	Aug-Nov	N	W
<i>Botrychium rugulosum</i> [= <i>B. ternatum</i> ]	leathery grapefern		N	W
<i>Botrychium virginianum</i>	rattlesnake fern	spring - eary summer	N	E,W
<b>ROYAL FERNS (Osmundaceae)</b>				
<i>Osmunda cinnamomea</i>	cinnamon fern	Apr-May	N	E
<i>Osmunda claytoniana</i>	interrupted fern	Mar-Jun	N	E,W
<b>POLYPODIES (Polypodiaceae)</b>				
<i>Polypodium virginianum</i> [= <i>P. vulgare</i> ]	common polypody	Jul-Aug	N	W
<b>MAIDENHAIR FERNS (Adiantaceae)</b>				
<i>Adiantum pedatum</i>	northern maidenhair fern	Jun-Sep	N	E,W
<b>SPLEENWORTS (Aspleniaceae)</b>				
<i>Athyrium filix-femina</i>	subarctic lady fern	Aug-Sep	N	E,W
<i>Cystopteris bulbifera</i>	bulblet fern	Jun-Sep	N	W
<i>Cystopteris tenuis</i>	fragile fern		N	W
<i>Dryopteris carthusiana</i>	spinulose woodfern		N	E,W
[= <i>D. austriaca</i> var. <i>spinulosa</i> ]				
<i>Dryopteris carthusiana</i>	spinulose woodfern		N	E,W
[= <i>D. austriaca</i> var. <i>spinulosa</i> ]				
<i>Dryopteris intermedia</i>	evergreen woodfern		N	W
[= <i>D. austriaca</i> var. <i>intermedia</i> ]				
<i>Dryopteris marginalis</i>	marginal shield-fern or woodfern	Jun-Oct	N	W
<i>Dryopteris</i> sp.	woodfern			E
<i>Polystichum acrostichoides</i>	Christmas fern	Jun-Oct	N	E,W
<i>Gymnocarpium dryopteris</i>	oak-fern		N(T)	W
<i>Phegopteris hexagonoptera</i>	broad beech-fern		N	W
<i>Polystichum acrostichoides</i>	Christmas fern	Jun-Oct	N	E,W
<b>SENSITIVE FERNS (Onocleaceae)</b>				
<i>Onoclea sensibilis</i>	sensitive fern	Jun-Oct	N	E,W
<b>PINES (Pinaceae)</b>				
<i>Picea pungens</i>	blue spruce	May	A	E
<i>Pinus nigra</i>	Austrian pine	May-Jun	A	E
<i>Pinus rigida</i>	pitch pine	May-Jun	N	E
<i>Pinus strobus</i>	eastern white pine	May-Jun	N	E
<i>Pinus sylvestris</i>	Scotch pine	May-Jun	A	E
<i>Tsuga canadensis</i>	eastern hemlock	May-Jun	N	E,W
<b>BALD CYPRESSES (Taxodiaceae)</b>				
<i>Metasequoia glyptostroboides</i>	dawn redwood	Apr-May	A	E



	Common Name	Phenology	Origin	Loc
<b>BARBERRIES (Berberidaceae)</b>				
<i>Berberis thunbergii</i>	Japanese barberry	May	A	E,W
<i>Berberis vulgaris</i>	European or common barberry	May-Jun	A	E
<i>Caulophyllum thalictroides</i>	blue cohosh	Apr-Jun	N	W
<i>Podophyllum peltatum</i>	may-apple	Apr-May	N	E,W
<b>MOONSEEDS (Menispermaceae)</b>				
<i>Menispermum canadense</i>	Canada moonseed	Jun-Jul	N	E,W
<b>POPIES (Papaveraceae)</b>				
<i>Chelidonium majus</i>	celandine	Apr-Aug	A	W
<i>Sanguinaria canadensis</i>	bloodroot	Mar-May	N	E,W
<b>FUMITORIES (Fumariaceae)</b>				
<i>Dicentra canadensis</i>	squirrel-corn	Apr-May	N	W
<i>Dicentra cucullaria</i>	Dutchman's breeches	Apr-May	N	E,W
<i>Fumaria officinalis</i>	fumitory	May-Aug	A	W
<b>PLANE-TREES (Platanaceae)</b>				
<i>Platanus occidentalis</i>	American sycamore	Apr-Jun	N	E,W
<b>WITCH HAZELS (Hamamelidaceae)</b>				
<i>Hamamelis virginiana</i>	American witch hazel	Sep-Nov	N	W
<b>ELMS (Ulmaceae)</b>				
<i>Celtis occidentalis</i>	common or northern hackberry	Oct-Nov	N	E,W
<i>Ulmus americana</i>	American or white elm	Mar-May	N	E,W
<i>Ulmus pumila</i>	Siberian elm	Apr-May	A	W
<i>Ulmus rubra</i>	slippery or red elm	Mar-Apr	N	E,W
<b>MULBERRIES (Moraceae)</b>				
<i>Maclura pomifera</i>	osage-orange	May-Jun	Z	W
<i>Morus alba</i>	white mulberry	May-Jun	C	E,W
<i>Morus rubra</i>	red mulberry	Jun-Jul	N	W
<b>NETTLES (Urticaceae)</b>				
<i>Boehmeria cylindrica</i>	small-spike false-nettle	Jul-Aug	N	E
<i>Laportea canadensis</i>	Canada wood-nettle	Jul-Aug	N	E
<i>Parietaria pensylvanica</i>	Pennsylvania pellitory	May-Sep	N	W
<i>Pilea fontana</i>	springs clearweed	Jul-Sep	N	E
<i>Pilea pumila</i>	Canada clearweed	Jul-Sep	N	E,W
<i>Urtica dioica</i>	stinging nettle	Jul-Aug	A	E,W
<i>Urtica dioica</i> ssp. <i>gracilis</i> [= <i>U. gracilis</i> ; <i>U. procera</i> ]	slender or tall nettle	Jul-Sep	A	E,W
<b>WALNUTS (Juglandaceae)</b>				
<i>Carya alba</i> [= <i>C. tomentosa</i> ]	mockernut hickory	May-Jun	N	E
<i>Carya cordiformis</i>	bitter-nut hickory	May	N	E,W
<i>Carya ovata</i>	shag-bark hickory	May	N	E,W
<i>Juglans cinerea</i>	butternut	May	N(P)	W
<i>Juglans nigra</i>	black walnut	Apr-May	N	E,W
<b>BEECHES (Fagaceae)</b>				
<i>Castanea dentata</i>	American chestnut	Jun-Aug	N(P)	E,W
<i>Fagus grandifolia</i> [= <i>F. ferruginea</i> ]	American beech	Apr-May	N	E,W
<i>Quercus alba</i>	white oak	May-Jun	N	E,W
<i>Quercus bicolor</i>	swamp white oak	May	N	E,W
<i>Quercus coccinea</i>	scarlet oak	May	N	E,W
<i>Quercus macrocarpa</i>	bur oak	May	N	E,W
<i>Quercus nigra</i>	water or black oak	May	N	E
<i>Quercus palustris</i>	pin oak	May-Jun	N	E,W
<i>Quercus rubra</i> var. <i>ambigua</i> [= <i>Q. borealis</i> ]	northern red oak	May-Jun	N	E,W
<i>Quercus velutina</i>	black oak	May	N	E,W

	Common Name	Phenology	Origin	Loc
<b>BIRCHES &amp; HAZELS (Betulaceae)</b>				
<i>Alnus serrulata</i>	brook-side or smooth alder	Mar-Apr	N	E
<i>Carpinus caroliniana</i>	American hornbeam, ironwood	Apr	N	W
<i>Corylus americana</i>	American hazel-nut	Mar-Apr	N	E,W
<i>Ostrya virginiana</i>	eastern hop-hornbeam	Apr-May	N	E,W
<b>POKEWEEDS (Phytolaccaceae)</b>				
<i>Phytolacca americana</i>	common pokeweed	Jun-Sep	N	E,W
<b>FOUR-O'CLOCKS (Nyctaginaceae)</b>				
<i>Mirabilis nyctaginea</i>	heart-leaf or wild four-o'clock	Sep	N	E
<b>GOOSEFOOTS &amp; PIGWEEDS (Chenopodiaceae)</b>				
<i>Atriplex</i> sp.	orache	Jun-Nov		W
<i>Chenopodium album</i>	white goosefoot, lamb's quarters	Sep	A	E,W
<i>Chenopodium simplex</i> [= <i>C. hybridum</i> ]	maple-leaved goosefoot	Jun-Oct	N	W
<i>Cycloloma atriplicifolium</i>	winged pigweed	Sep	N	E
<i>Salsola kali</i>	Russian thistle, saltwort	Aug-Sep	A	E
<b>AMARANTHS (Amaranthaceae)</b>				
<i>Amaranthus albus</i>	white amaranth, tumbleweed	Sep	N	E
<i>Amaranthus retroflexus</i>	red-root amaranth, pigweed	Aug-Sep	N	E
<i>Amaranthus tuberculatus</i>	rough-fruit amaranth	Aug-Oct	N	E
<i>Amaranthus</i> sp.	pigweed	Aug-Oct		W
<b>PURSLANES (Portulacaceae)</b>				
<i>Claytonia virginica</i>	narrow-leaf spring-beauty	early spring	N	E,W
<i>Portulaca oleracea</i>	common purslane	Jun-Sep	A	E,W
<b>CARPET-WEEDS (Molluginaceae)</b>				
<i>Mollugo verticillata</i>	green carpet-weed	Jun-Nov	Z	W
<b>PINKS (Caryophyllaceae)</b>				
<i>Arenaria serpyllifolia</i>	thyme-leaf sandwort	Apr-Aug	A	W
<i>Cerastium arvense</i>	field chickweed	Apr-Aug	N	E
<i>Cerastium fontanum</i>	mouse-ear chickweed	Apr-Oct	A	E
<i>Cerastium fontanum</i> ssp. <i>vulgare</i> [= <i>C. vulgatum</i> ]	common mouse-ear chickweed	Apr-Oct	A	E,W
<i>Dianthus armeria</i>	Deptford pink	May-Jul	A	W
<i>Saponaria officinalis</i>	bouncing-bet	Jun-Sep	A	E,W
<i>Silene antirrhina</i>	sleepy catchfly	May-Sep	N	W
<i>Silene latifolia</i> ssp. <i>alba</i> [= <i>S. pratensis</i> ]	white campion	Apr-Aug	A	W
<i>Stellaria graminea</i>	lesser starwort or stitchwort	May-Oct	A	W
<i>Stellaria longifolia</i>	long-leaf starwort or stitchwort	May-Jul	N	W
<i>Stellaria media</i>	common chickweed	Feb-Dec	A	W
<i>Stellaria pubera</i>	great chickweed	Apr-Jun	N	E
<b>BUCKWHEATS (Polygonaceae)</b>				
□ <i>Polygonum amphibium</i> var. <i>emersum</i> [= <i>P. coccineum</i> ]	water smartweed	Aug-Sep	N	E
<i>Polygonum aviculare</i>	prostrate knotweed or smartweed	Jun-Nov	N	E,W
<i>Polygonum convolvulus</i>	black bindweed	Jun-Sep	A	E
<i>Polygonum cuspidatum</i>	Japanese knotweed	Aug-Sep	A	W
<i>Polygonum hydropiper</i>	marshpepper smartweed, water-pepper	Jun-Nov	A	E,W
<i>Polygonum hydropiperoides</i>	swamp smartweed, water-pepper	Jun-Nov	N	E
<i>Polygonum lapathifolium</i>	willow-weed, nodding smartweed	Aug-Sep	N	E,W
<i>Polygonum pennsylvanicum</i> [= <i>P. p.</i> var. <i>eglandulosum</i> ]	Pennsylvania smartweed, Lake Erie pinkweed	Aug-Sep	N	E,W
<i>Polygonum persicaria</i>	lady's thumb	Jul-Sep	A	E,W
<i>Polygonum punctatum</i>	dotted or water smartweed	Aug-Sep	N	E
<i>Polygonum sagittatum</i>	arrow-leaf tearthumb, arrow-vine	Sep	N	E,W
<i>Polygonum scandens</i>	climbing false-buckwheat	Aug-Nov	N	W

	Common Name	Phenology	Origin	Loc
<b>BUCKWHEATS (cont'd)</b>				
<i>Polygonum virginianum</i> [= <i>Tovara virginiana</i> ]	Virginia knotweed, jumpseed	Aug	N	E,W
<i>Rumex acetosella</i>	garden sorrel, sheep sorrel	Jun-Oct A	E,W	
<i>Rumex crispus</i>	curly or sour dock	Jun-Sep	A	E,W
<i>Rumex orbiculatus</i>	great water dock	Sep	N	E
<i>Rumex verticillatus</i>	swamp dock	Jun-Sep	N	E
<b>GARCINIAS (Clusiaceae)</b>				
<i>Hypericum ascyron</i> [= <i>H. pyramidatum</i> ]	great St. John's-wort	Jun-Aug	N	W
<i>Hypericum majus</i>	large Canadian St. John's-wort	Jul-Sep	N(P)	E
<i>Hypericum perforatum</i>	common St. John's-wort	Jun-Sep	A	E,W
<i>Hypericum punctatum</i>	dotted or spotted St. John's-wort	Aug	N	E,W
<b>LINDENS (Tiliaceae)</b>				
<i>Tilia americana</i>	American basswood	Jul	N	E,W
<b>MALLOWS (Malvaceae)</b>				
<i>Abutilon theophrasti</i>	velvet-leaf	Jul-Oct	A	E,W
<i>Hibiscus moscheutos</i> [= <i>H. palustris</i> ]	swamp rosemallow	Aug-Sep	N	E
<i>Hibiscus trionum</i>	flower-of-the-hour	Jul-Sep	A	E,W
<i>Malva moschata</i>	musk mallow	Jun-Sep	A	W
<i>Malva neglecta</i>	common mallow	Apr-Oct	A	W
<i>Malva sylvestris</i>	high mallow	Jun-Aug	A	W
<b>SUNDEWS (Droseraceae)</b>				
<i>Drosera rotundifolia</i>	round-leaf sundew	Jun-Aug	N(P)	W
<b>ROCKROSES (Cistaceae)</b>				
<i>Helianthemum bicknellii</i> [= <i>H. majus</i> misapplied]	plains frostweed	Jun-Jul	N(T)	E,W
<i>Lechea minor</i>	pinweed	Jul-Nov	N(T)	W
<b>VIOLETS (Violaceae)</b>				
<i>Viola blanda</i>	sweet white violet	Apr-May	N	W
<i>Viola canadensis</i>	Canada violet	Apr-Jun	N	E
<i>Viola conspersa</i>	American dog violet	May-Jul	N	E
<i>Viola cucullata</i>	marsh blue violet	May	N	E,W
<i>Viola odorata</i>	white violet	Apr-May	A	W
<i>Viola palmata</i> [= <i>V. triloba</i> ]	three-lobed violet	Apr-May	N	W
<i>Viola pubescens</i>	downy or common yellow violet	May	N	E,W
<i>Viola rostrata</i>	long-spur violet	Apr-Jun	N	W
<i>Viola sagittata</i>	arrow-leaf violet	Apr-Jun	N	W
<i>Viola sororia</i>	woolly blue violet, freckled violet	Apr-Jun	N	E,W
<i>Viola striata</i>	striped cream violet, pale violet	May	N	E,W
<b>GOURDS (Cucurbitaceae)</b>				
<i>Echinocystis lobata</i>	wild mock-cucumber	Jul-Sep	N	E,W
<b>WILLOWS (Salicaceae)</b>				
<i>Populus deltoides</i>	eastern cotton-wood	Apr-May	N	E,W
<i>Populus grandidentata</i>	big-tooth aspen	Apr	N	E,W
<i>Salix alba</i>	white willow	Apr-May	A	E
<i>Salix amygdaloides</i>	peach-leaf willow	Apr-Jun	N	E
<i>Salix babylonica</i>	weeping willow	Feb-May	A	E
<i>Salix discolor</i>	pussy willow	Feb-May	N	W
<i>Salix eriocephala</i> [= <i>S. rigida</i> ]	Missouri River or heart-leaf willow	Mar-Apr	N	W
<i>Salix exigua</i> [= <i>S. interior</i> ]	sandbar willow	May-Jun	N	E,W
<i>Salix fragilis</i>	crack willow	Apr-Jun	A	E
<i>Salix humilis</i>	tall prairie willow	Mar-Jun	N	W
<i>Salix nigra</i>	black willow	Apr-Jun	N	E,W
<b>CAPERS (Capparaceae)</b>				
<i>Polanisia dodecandra</i>	rough-seed clammy-weed	Jul-Sep	N	E

MUSTARDS (Brassicaceae)	Common Name	Phenology	Origin	Loc
<i>Alliaria petiolata</i> [= <i>A. officinalis</i> ]	garlic mustard	Jul-Sep	A	E,W
<i>Arabidopsis thaliana</i>	mouse-ear cress	Mar-Jun	A	W
<i>Arabis laevigata</i>	smooth rock cress	Apr-Jun	N	E,W
<i>Barbarea vulgaris</i>	yellow rocket, common winter-cress	Jun	A	E,W
<i>Brassica nigra</i>	black mustard	Jun-Oct	A	W
<i>Brassica rapa</i> [= <i>B. campestris</i> ]	field mustard	May-Oct	A	E
<i>Cakile edentula</i>	American or inland searocket	Jul-Sep	N(P)	E
<i>Capsella bursa-pastoris</i>	common shepherd's purse	Mar-Dec	A	W
<i>Cardamine bulbosa</i>	bulbous bitter-cress, spring cress	Apr-Jun	N	E,W
<i>Cardamine concatenata</i> [= <i>Dentaria laciniata</i> ]	cut-leaf toothwort	Apr-May	N	E,W
<i>Cardamine diphylla</i> [= <i>Dentaria diphylla</i> ]	two-leaf or common toothwort	Apr-May	N	W
<i>Cardamine douglassii</i>	purple bitter-cress	Apr-May	N	E,W
<i>Cardamine hirsuta</i>	hairy bitter-cress	Mar-Apr	A	W
<i>Cardamine pennsylvanica</i>	Pennsylvania bitter-cress	Jun-Jul	N	E,W
<i>Draba verna</i> [= <i>Erophila verna</i> ]	whitlow-grass	Apr-May	A	W
<i>Erysimum repandum</i>	treacle mustard	May-Jul	A	W
<i>Hesperis matronalis</i>	dame's rocket	May-Jun	A	E,W
<i>Lepidium campestre</i>	cow cress	May-Jun	N	W
<i>Lepidium virginicum</i>	poor-man's pepper-grass	May-Sep	N	W
<i>Lunaria annua</i>	moneyplant	May-Jun	C	W
<i>Noebeckia aquatica</i> [= <i>Armoracia aquatica</i> , <i>Nasturtium lacustre</i> ]	lakecress	May-Aug	N	E,W
<i>Rorippa nasturtium-aquaticum</i> [= <i>Nasturtium officinale</i> ]	true water-cress	Apr-Jun	A	W
<i>Rorippa palustris</i>	marsh yellow-cress	Jun-Oct	N	W
<i>Rorippa palustris</i> ssp. <i>hispida</i> [= <i>R. palustris</i> var. <i>hispida</i> ]	bog yellow-cress, marsh cress	Jun-Jul	N	E
<i>Sinapis alba</i> [= <i>Brassica hirta</i> ]	white mustard	Jun-Aug	A	E
<i>Sinapis arvensis</i> [= <i>Brassica kaber</i> ]	charlock	May-Jul	A	E
<i>Sisymbrium officinale</i>	hedge mustard	May-Oct	A	W
<i>Thlaspi arvense</i>	field penny-cress	Apr-Jun	A	W
<b>HEATHS (Ericaceae)</b>				
<i>Epigaea repens</i>	trailing arbutus, ground laurel	Mar-May	N	W
<i>Gaultheria procumbens</i>	creeping wintergreen	Jul-Aug	N	W
<i>Vaccinium macrocarpon</i> [= <i>Oxycoccus macrocarpus</i> ]	American or large cranberry	Jun-Aug	N(P)	W
<i>Vaccinium pallidum</i> [= <i>V. vacillans</i> ]	low or hillside blueberry	Apr-Jun	N	E,W
<b>WINTERGREENS (Pyrolaceae)</b>				
<i>Chimaphila umbellata</i>	prince's pine	Jul-Aug	N(T)	W
<i>Pyrola americana</i> [= <i>P. rotundifolia</i> ]	round-leaf wintergreen	Jun-Aug	N	W
<b>INDIAN PIPES (Monotropaceae)</b>				
<i>Monotropa uniflora</i>	Indian-pipe	Jun-Sep	N	W
<b>PRIMROSES (Primulaceae)</b>				
<i>Lysimachia ciliata</i>	fringed loosestrife	Jul-Sep	N	E,W
<i>Lysimachia nummularia</i>	creeping Jennie, moneywort	Jun-Aug	A	E,W
<i>Lysimachia quadrifolia</i>	whorled or prairie loosestrife	Jun-Jul	N	E,W
<i>Samolus valerandi</i>	water pimpernel	May-Sep	N	W
<b>HYDRANGEAS (Hydrangeaceae)</b>				
<i>Hydrangea arborescens</i>	wild hydrangea	Jun-Jul	N	E
<i>Philadelphus coronarius</i>	mock orange, syringa	Jun-Jul	A	W
<b>GOOSEBERRIES (Grossulariaceae)</b>				
<i>Ribes americanum</i>	wild or American black currant	Apr-Sep	N	W
<i>Ribes cynosbati</i>	bristly gooseberry, dogberry	May-Sep	N	W

	Common Name	Phenology	Origin	Loc
<b>GOOSEBERRIES (cont'd)</b>				
<i>Ribes rubrum</i> [= <i>R. sativum</i> ]	red currant	Apr-Jun	A	E,W
<i>Ribes uva-crispa</i>	garden gooseberry	May-Jun	A	E
<b>ORPINES (Crassulaceae)</b>				
<i>Sedum telephium</i>	live-forever	Aug-Sep	A	E
<i>Sedum ternatum</i>	wild sedum	Apr-Jun	N	W
<b>SAXIFRAGES (Saxifragaceae)</b>				
<i>Heuchera americana</i>	American alum-root	Apr-Jul	N	E,W
<i>Mitella diphylla</i>	two-leaf bishop's-cap, mitrewort	Apr-May	N	W
<i>Penthorum sedoides</i>	ditch-stonecrop	Jul-Sep	N	E
<b>ROSES (Rosaceae)</b>				
<i>Agrimonia gryposepala</i>	tall hairy grooverbur, agrimony	Jul-Aug	N	E,W
<i>Agrimonia parviflora</i>	small-flower groovebur	Jul-Sep	N	E,W
<i>Agrimonia pubescens</i>	downy agrimony	Jul-Sep	N	W
<i>Amelanchier arborea</i>	downy service-berry	Apr	N	E,W
<i>Amelanchier laevis</i>	smooth service-berry, Juneberry	Apr-Jun	N	W
<i>Aronia melanocarpa</i> [= <i>Pyrus arbutifolia melanocarpa</i> ]	black chokeberry	Apr-Nov	N	W
<i>Crataegus crus-galli</i>	cockspur hawthorn	May-Oct	N	W
<i>Crataegus mollis</i>	downy hawthorn	Sep-Oct	N	E
<i>Crataegus punctata</i>	dotted hawthorn	May-Oct	N	W
<i>Crataegus</i> spp.	hawthorns	May-Jun	A	E,W
<i>Duchesnea indica</i>	Indian mock-strawberry	Apr-Jun	A	W
<i>Fragaria vesca</i>	woodland strawberry	May-Aug	A	W
<i>Fragaria virginiana</i>	Virginia or wild strawberry	Apr-Jun	N	E,W
<i>Geum canadense</i>	white avens	Jun	N	E,W
<i>Geum laciniatum</i>	rough avens	Jun	N	E,W
<i>Geum vernum</i>	spring or vernal avens	Apr-Jun	N	W
<i>Malus coronaria</i> [= <i>Pyrus coronaria</i> ; <i>M. angustifolia</i> ]	wild crab, southern crab-apple	Mar-May	N	E,W
<i>Malus pumila</i>	apple	Apr-Jun	A	E
<i>Potentilla canadensis</i>	running five-finger, cinquefoil	Apr-Jun	N	E
<i>Potentilla norvegica</i>	Norwegian or rough cinquefoil	Jun-Aug	N	E,W
<i>Potentilla recta</i>	rough-fruited cinquefoil	Jun-Aug	A	E,W
<i>Potentilla simplex</i>	old-field or common cinquefoil	Apr-Jun	N	E,W
<i>Prunus americana</i>	American or wild plum	May-Jun	N	E,W
<i>Prunus avium</i>	sweet cherry	Apr-Jul	A	W
<i>Prunus pensylvanica</i>	pin cherry	Apr-May	N	E
<i>Prunus serotina</i>	black or wild cherry	May	N	E,W
<i>Prunus virginiana</i>	choke cherry	Aug-Oct	N	W
<i>Rosa blanda</i>	smooth stem rose	Jun	N(T)	E
<i>Rosa carolina</i>	pasture or wild rose	Jun-Jul	N	E,W
<i>Rosa multiflora</i>	multiflora rose	Jun-Jul	A	E,W
<i>Rosa palustris</i>	swamp rose	Jun-Aug	N	E,W
<i>Rosa setigera</i>	prairie or climbing rose	Jun-Jul	N	E,W
<i>Rubus allegheniensis</i>	Allegheny blackberry	May-Jul	N	W
<i>Rubus canadensis</i>	smooth blackberry	Jun-Jul	N	E
<i>Rubus flagellaris</i>	northern dewberry	May-Jun	N	E
<i>Rubus hispidus</i>	bristly or running swamp blackberry	Jun-Aug	N	W
<i>Rubus occidentalis</i>	black raspberry	May-Jun	N	E,W
<i>Rubus odoratus</i>	flowering raspberry	Jun-Aug	N	E
<i>Spiraea alba</i>	narrow-leaf meadow-sweet	Jun-Aug	N	E
<b>CAESALPINIAS (Caesalpiniaceae)</b>				
<i>Cercis canadensis</i>	eastern redbud	Mar-May	N	E,W
<i>Gleditsia triacanthos</i>	honey-locust	May-Jun	N	W
<i>Gymnocladus dioica</i> [= <i>G. canadensis</i> ]	Kentucky coffee-tree	May	N	E,W



PEAS (Fabaceae)	Common Name	Phenology	Origin	Loc
<i>Amorpha fruticosa</i>	false indigo-bush	May-Jun	N	E
<i>Amphicarpaea bracteata</i>	American hog-peanut	Aug-Sep	N	E,W
<i>Apios americana</i>	American potato-bean, groundnut	Jul-Aug	N	E,W
<i>Astragalus canadensis</i>	Canada milkvetch	Jul-Aug	N	E
<i>Baptisia tinctoria</i>	wild indigo	May-Sep	N	W
<i>Coronilla varia</i>	crown vetch	Jun-Aug	A	W
<i>Desmodium canadense</i>	showy tick-trefoil	Jul-Aug	N	E,W
<i>Desmodium canescens</i>	hoary tick-trefoil	Jul-Sep	N	E
<i>Desmodium ciliare</i>	little-leaf tick-trefoil	Jul-Aug	N	W
<i>Desmodium glutinosum</i>	cluster-leaf tick-trefoil	Jul	N	E
<i>Desmodium laevigatum</i>	smooth tick-trefoil	Jul-Aug	N	E
<i>Desmodium paniculatum</i>	panicked tick-trefoil	Jul-Aug	N	E,W
<i>Desmodium pauciflorum</i>	few-flowered tick-trefoil	Jul-Aug	N(P)	W
<i>Lathyrus latifolius</i>	everlasting pea	Jun-Sep	A	W
<i>Lathyrus tuberosus</i>	tuberous vetchling	Jun-Aug	A	W
<i>Lespedeza capitata</i>	round-head bush clover	Jul-Sep	N	E,W
<i>Lespedeza hirta</i> [= <i>L. polystachya</i> ]	hairy bush clover	Jul-Oct	N	W
<i>Lespedeza virginica</i>	Virginia bush clover	Aug-Sep	N	E
<i>Lotus corniculatus</i>	bird's-foot trefoil	Jun-Sep	A	W
<i>Lupinus perennis</i>	wild or sundial lupine	Apr-Jul	N(P)	W
<i>Medicago lupulina</i>	black medick	May-Sep	A	E,W
<i>Melilotus albus</i> [= <i>M. alba</i> ]	white sweetclover	Jul-Sep	A	E,W
<i>Melilotus officinalis</i>	yellow sweetclover	Jun-Sep	A	E,W
<i>Robinia pseudoacacia</i>	black locust	May-Jun	Z	E,W
<i>Strophostyles helvula</i>	trailing wildbean	Jun-Sep	N	E,W
<i>Trifolium campestre</i> [= <i>T. procumbens</i> ]	pinnate or lesser hop-clover	May-Sep	A	W
<i>Trifolium hybridum</i>	alsike clover	May-Oct	A	W
<i>Trifolium pratense</i>	red clover	May-Aug	A	E,W
<i>Trifolium repens</i>	white clover	All summer	A	E,W
<i>Vicia cracca</i>	bird vetch	Jul-Aug	A	E
<i>Vicia</i> sp.	vetch	May-Sep		W
<b>OLEASTERS (Elaeagnaceae)</b>				
<i>Elaeagnus angustifolia</i>	Russian olive	Jun-Jul	A	E
<i>Elaeagnus umbellata</i>	autumn-olive	May-Jun	A	W
<b>WATER MILFOILS (Haloragaceae)</b>				
<i>Myriophyllum spicatum</i>	Eurasian water-milfoil	Jul-Sep	N	E
<i>Proserpinaca palustris</i>	marsh or common mermaid-weed	Jul-Aug	N	E
<b>LOOSESTRIFES (Lythraceae)</b>				
<i>Decodon verticillatus</i>	hairy swamp-loosestrife	Jul-Sep	N	E
<i>Lythrum alatum</i>	winged loosestrife	Jun-Sep	N	E
<i>Lythrum salicaria</i>	purple loosestrife	Jun-Sep	A	E
<b>EVENING-PRIMROSE (Onagraceae)</b>				
<i>Circaea lutetiana</i> [= <i>C. quadrisulcata</i> ]	common enchanter's nightshade	Jun-Aug	N	E,W
<i>Epilobium ciliatum</i>	hairy or northern willow-herb	Jun-Aug	N	E,W
<i>Epilobium ciliatum</i> ssp. <i>glandulosum</i> [= <i>E. glandulosum</i> ]	willow-herb	Jul-Sep	N	E
<i>Gaura biennis</i>	biennial butterfly-weed or gaura	Aug-Sep	N	E
<i>Ludwigia alternifolia</i>	bushy seedbox	Jun-Aug	N	W
<i>Ludwigia palustris</i>	marsh seedbox, water-purslane	Aug	N	E
<i>Oenothera biennis</i>	common evening-primrose	Jun-Sep	N	E,W
<i>Oenothera perennis</i> [= <i>O. pumila</i> ]	small evening-primrose	May-Aug	N	W
<b>DEERGRASSES (Melastomataceae)</b>				
<i>Rhexia virginica</i>	Virginia meadow-beauty, deergrass	Jul-Sep	N(P)	W
<b>DOGWOODS (Cornaceae)</b>				
<i>Cornus alternifolia</i>	alternate-leaf or pagoda dogwood	May-Sep	N	W
<i>Cornus amomum</i>	silky or knob-styled dogwood	May-Jul	N	E,W

	Common Name	Phenology	Origin	Loc
<b>DOGWOODS (cont'd)</b>				
<i>Cornus drummondii</i>	rough-leaf dogwood	May-Jun	N	E,W
<i>Cornus florida</i>	flowering dogwood	Apr-May	N	E,W
<i>Cornus racemosa</i>	gray dogwood	May-Oct	N	E,W
<i>Cornus rugosa</i>	round-leaved dogwood	May-Oct	N(P)	W
<i>Cornus sericea</i> [= <i>C. stolonifera</i> ]	red-osier dogwood	May-Aug	N	E,W
<i>Nyssa sylvatica</i>	black gum	May-Jun	N	E,W
<b>SANDALWOODS (Santalaceae)</b>				
<i>Comandra umbellata</i>	umbellate bastard-toadflax	May-Jul	N	E
<b>STAFF-TREES (Celastraceae)</b>				
<i>Celastrus scandens</i>	American bitterweet	Jun	N	E,W
<i>Euonymus fortunei</i>	bigleaf or Chinese wintercreeper	May	A	E,W
<b>HOLLIES (Aquifoliaceae)</b>				
<i>Ilex verticillata</i>	common winterberry	May-Jun	N	E
<b>SPURGES (Euphorbiaceae)</b>				
<i>Acalypha virginica</i> var. <i>rhomboidea</i> [= <i>A. rhomboidea</i> ]	three-seed mercury	Sep	N	E,W
<i>Chamaesyce maculata</i> [= <i>Euphorbia maculata</i> ]	spotted broomspurge	Jun-Oct	N	W
<i>Chamaesyce nutans</i> [= <i>E. nutans</i> ]	eyebane broomspurge	Jun-Oct	N	W
<i>Chamaesyce polygonifolia</i> [= <i>Euphorbia polygonifolia</i> ]	seaside broomspurge, seaside spurge	Jul-Oct	N(P)	E
<i>Euphorbia corollata</i>	flowering spurge	Jun-Sep	N	E
<i>Euphorbia cyparissias</i>	cypress spurge	Apr-Aug	A	W
<i>Euphorbia dentata</i>	toothed spurge	Jun-Sep	N	E
<b>BUCKTHORNS (Rhamnaceae)</b>				
<i>Ceanothus americanus</i>	New Jersey tea	Jun-Jul	N	E,W
<i>Frangula alnus</i> [= <i>R. frangula</i> ]	glossy buckthorn	May-Jul	A	W
<i>Rhamnus cathartica</i>	European or common buckthorn	May-Jun	A	W
<b>GRAPES (Vitaceae)</b>				
<i>Parthenocissus quinquefolia</i> [= <i>P. inserta</i> ]	Virginia or thicket creeper	Jun	N	E,W
<i>Vitis aestivalis</i>	summer grape	May-Oct	N	E,W
<i>Vitis labrusca</i>	northern fox grape	May-Oct	N(P)	W
<i>Vitis riparia</i>	riverbank grape	May-Jul	N	E,W
<i>Vitis vulpina</i> [= <i>V. cordifolia</i> ]	frost or chicken grape	May-Oct	N	W
<b>FLAXES (Linaceae)</b>				
<i>Linum virginianum</i>	Virginia flax	Jul-Aug	N	W
<b>MILKWORTS (Polygalaceae)</b>				
<i>Polygala sanguinea</i>	red milkwort	Jun-Oct	N	W
<i>Polygala verticillata</i>	whorled milkwort	Jul-Oct	N	E
<b>BLADDER-NUTS (Staphyleaceae)</b>				
<i>Staphylea trifolia</i>	American bladdernut	May	N	E
<b>HORSE-CHESTNUTS (Hippocastanaceae)</b>				
<i>Aesculus glabra</i>	Ohio buckeye	Apr-May	N	E,W
<b>MAPLES (Aceraceae)</b>				
<i>Acer negundo</i> var. <i>negundo</i> [= <i>Negundo aceroides</i> ]	box-elder	Apr-Oct	N	W
<i>Acer nigrum</i>	black maple	May-Sep	N	W
<i>Acer palmatum</i>	Japanese maple		A	E
<i>Acer platanoides</i>	Norway maple	Apr-May	A	E,W
<i>Acer rubrum</i>	red maple	Mar-Apr	N	E,W
<i>Acer saccharinum</i>	silver maple	Mar-Apr	N	E,W

	Common Name	Phenology	Origin	Loc
<b>MAPLES (cont'd)</b> <i>Acer saccharum</i>	sugar maple	Apr-Jun	N	E,W
<b>CASHEWS (Anacardiaceae)</b> <i>Rhus glabra</i> <i>Rhus hirta</i> [= <i>R. typhina</i> ] <i>Toxicodendron radicans</i> [= <i>R. radicans</i> ]	smooth sumac staghorn sumac poison ivy	Jun-Jul Jun-Aug May-Jun	N N N	E,W E,W E,W
<b>QUASSIAS (Simaroubaceae)</b> <i>Ailanthus altissima</i> [= <i>A. glandulosa</i> ]	Chinese sumach	Jun-Jul	A	W
<b>RUES (Rutaceae)</b> <i>Zanthoxylum americanum</i>	common prickly-ash	Apr-May	N	W
<b>WOOD SORRELS (Oxalidaceae)</b> <i>Oxalis stricta</i> [= <i>O. europaea</i> ] <i>Oxalis violacea</i>	common yellow wood sorrel violet wood sorrel	Aug Apr-Jun	N N	E,W E,W
<b>GERANIUMS (Geraniaceae)</b> <i>Erodium cicutarium</i> <i>Geranium carolinianum</i> <i>Geranium maculatum</i> <i>Geranium pusillum</i>	redstem-filaree, storks-bill Carolina crane's-bill purple crane's-bill, wild geranium small-flowered crane's-bill	Apr-Oct May-Jul Apr-Jun Jun-Oct	A N N A	W W E,W W
<b>MEADOW-FOAMS (Limnanthaceae)</b> <i>Floerkea proserpinacoides</i>	false mermaid-weed	Apr-May	N	E,W
<b>JEWELWEEDS (Balsaminaceae)</b> <i>Impatiens capensis</i> <i>Impatiens pallida</i>	spotted touch-me-not, jewelweed pale touch-me-not	Jun-Sep Jun-Sep	N N	E,W E,W
<b>GINSENGS (Araliaceae)</b> <i>Panax quinquefolius</i> <i>Panax trifolius</i>	American ginseng dwarf ginseng	Jul-Aug Apr-Jun	N N	W W
<b>CARROTS (Apiaceae)</b> <i>Chaerophyllum procumbens</i> <i>Cicuta maculata</i> <i>Cryptotaenia canadensis</i> <i>Daucus carota</i> <i>Heracleum maximum</i> <i>Osmorhiza claytonii</i> <i>Osmorhiza longistylis</i> <i>Pastinaca sativa</i> <i>Sanicula canadensis</i> <i>Sium suave</i> <i>Taenidia integerrima</i> <i>Thaspium trifoliatum</i> <i>Zizia aurea</i>	spreading chervil spotted water-hemlock Canada honewort wild carrot, Queen Anne's lace cow-parsnip hairy or woolly sweetcicely smooth sweetcicely wild parsnip Canada sanicle or black snakeroot hemlock water-parsnip yellow pimpernel smooth meadow-parsnip golden alexanders	Apr-May Jun-Aug Jun-Jul May-Oct Jun-Aug May-Jun May-Jun May-Oct Jun-Aug Jul-Sep Apr-Jun May-Jun Apr-Jun	N N N A N N N A N N N N N N	W E,W E,W E,W W E,W E,W W E,W E E E W
<b>GENTIANS (Gentianaceae)</b> <i>Bartonia virginica</i> <i>Frasera caroliniensis</i> [= <i>Swertia c.</i> ] <i>Gentiana andrewsii</i> <i>Gentianella tenella</i> [= <i>Bartonia tenella</i> ] <i>Gentianopsis crinita</i> = <i>Gentiana crinita</i> <i>Sabatia angularis</i>	yellow screwstem American columbo fringe-top bottle or closed gentian gentian fringed gentian square-stem rose-gentian	Jul-Sep May-Jun Sep Aug-Sep Sep-Nov Jul-Sep	N N N N N(P) N	W E,W E W W E,W
<b>DOGBANES (Apocynaceae)</b> <i>Apocynum cannabinum</i> <i>Apocynum sibiricum</i> <i>Vinca minor</i>	Indian hemp clasping-leaf dogbane periwinkle	Jun-Sep Jun-Sep Mar-Jun	N N(E) A	E,W E W

	Common Name	Phenology	Origin	Loc
<b>MILKWEEDS (Asclepiadaceae)</b>				
<i>Asclepias incarnata</i>	swamp milkweed	Jun-Aug	N	E,W
<i>Asclepias sullivantii</i>	smooth milkweed	Jun-Jul	N	E
<i>Asclepias syriaca</i>	common milkweed	Jun-Aug	N	E,W
<i>Asclepias tuberosa</i>	butterfly-weed	Jun-Sep	N	E,W
<b>NIGHTSHADES (Solanaceae)</b>				
<i>Datura stramonium</i>	jimsonweed	Jun-Aug	Z	E,W
<i>Physalis heterophylla</i>	clammy ground-cherry	Jul-Sep	N	W
<i>Physalis</i> sp.	ground-cherry	Jun-Oct		W
<i>Solanum carolinense</i>	horse-nettle	May-Oct	Z	W
<i>Solanum dulcamara</i>	climbing or bitter-sweet nightshade	Jun-Sep	A	E,W
<i>Solanum ptychanthum</i> [= <i>S. nigrum</i> misapplied]	black or common nightshade	May-Sep	N	E,W
<b>MORNING-GLORIES (Convolvulaceae)</b>				
<i>Calystegia sepium</i> [= <i>Convolvulus sepium</i> ]	hedge bindweed	May-Sep	N	E,W
<i>Convolvulus arvensis</i>	field bindweed	May-Sep	A	E,W
<i>Ipomoea pandurata</i>	wild sweet-potato vine	Jun-Sep	N	W
<i>Ipomoea purpurea</i>	common morning-glory	Jul-Oct	A	W
<b>DODDERS (Cuscutaceae)</b>				
<i>Cuscuta gronovii</i>	common dodder	Jul-Oct	N	E,W
<i>Cuscuta polygonorum</i>	smartweed dodder	Jul-Sep	N	E
<b>PHLOXES (Polemoniaceae)</b>				
<i>Phlox divaricata</i>	woodland or blue phlox	Apr-Jun	N	E,W
<i>Phlox subulata</i>	ground phlox, moss-pink	Apr-May	N	W
<b>WATERLEAFS (Hydrophyllaceae)</b>				
<i>Hydrophyllum virginianum</i>	Virginia waterleaf	May-Jun	N	E,W
<b>BORAGES (Boraginaceae)</b>				
<i>Buglossoides arvensis</i> [= <i>Lithospermum arvense</i> ]	corn gromwell	Apr-Jun	A	W
<i>Cynoglossum officinale</i>	hound's-tongue	May-Jul	A	W
<i>Hackelia virginiana</i>	Virginia stickseed	Jun-Sep	N	W
<i>Mertensia virginica</i>	Virginia bluebells or cowslip	Apr-May	N	W
<i>Symphytum officinale</i>	common comfrey	Jun-Aug	A	E
<b>VERVAINS (Verbenaceae)</b>				
<i>Phryma leptostachya</i>	lopseed	Jun-Aug	N	E,W
<i>Verbena hastata</i>	blue vervain	Jul-Sep	N	E,W
<i>Verbena urticifolia</i>	white vervain	Jun-Oct	N	E,W
<i>Verbena x illicita</i>	hybrid vervain	Jul-Aug	N	E
<b>MINTS (Lamiaceae)</b>				
<i>Agastache nepetoides</i>	yellow giant-hyssop	Jul-Sep	N	W
<i>Agastache scrophulariifolia</i> [= <i>Lophanthus scrophulariifolius</i> ]	purple giant-hyssop	Jul-Sep	N	W
<i>Collinsonia canadensis</i>	Canada horse-balm	Jul-Sep	N	E
<i>Glechoma hederacea</i>	ground ivy	Apr-Jul	A	W
<i>Lamium amplexicaule</i>	henbit, dead nettle	Mar0Nov	A	W
<i>Lamium purpureum</i>	purple or red dead nettle	Apr-Oct	A	E,W
<i>Leonurus cardiaca</i>	motherwort, lion's tail	Jun-Aug	A	W
<i>Lycopus americanus</i>	American bugleweed	Jun-Sep	N	E,W
<i>Lycopus europaeus</i>	European bugleweed	Jun-Sep	A	E
<i>Lycopus rubellus</i>	taper-leaf bugleweed	Jul-Oct	N	W
<i>Lycopus uniflorus</i>	northern bugleweed, water horehound	Jun-Sep	N	E
<i>Lycopus virginicus</i>	Virginia bugleweed	Jun-Sep	N	E,W
<i>Lycopus x sherardii</i>	hybrid water horehound	Jun-Sep	N	E

<b>MINTS (cont'd)</b>	<b>Common Name</b>	<b>Phenology</b>	<b>Origin</b>	<b>Loc</b>
<i>Mentha arvensis</i> [= <i>M. gentilis</i> ]	field mint	Jul-Aug	N	E,W
<i>Mentha spicata</i>	spearmint	Jun-Oct	A	W
<i>Mentha x gracilis</i> [= <i>M. x cardiaca</i> ]	small-leaf mint	Jul-Aug	A	E
<i>Monarda fistulosa</i>	wild bergamot	Jun-Sep	N	E,W
<i>Nepeta cataria</i>	catnip	Jun-Oct	A	E,W
<i>Prunella vulgaris</i>	heal-all, self-heal	Jun-Oct	A	E,W
<i>Pycnanthemum virginianum</i>	Virginia mountain-mint	Jul-Sep	N	E
<i>Scutellaria galericulata</i> [= <i>S. epilobiiifolia</i> ]	hooded or marsh skullcap	Jun-Aug	N	E
<i>Scutellaria lateriflora</i>	blue or mad-dog skullcap	Jul-Sep	N	E,W
<i>Stachys tenuifolia</i> [= <i>S. t.</i> var. <i>hispidia</i> ; <i>S. hispidia</i> ]	smooth or common hedgenettle	Jun-Aug	N	E,W
<i>Teucrium canadense</i>	American germander	Jun-Aug	N	E
<i>Teucrium canadense</i> var. <i>virginicum</i>	germander	Jul-Sep	N	W
<b>WATER-STARWORTS</b>				
<b>(Callitrichaceae)</b>				
<i>Callitriche heterophylla</i>	larger water-starwort	Apr-Dec	A	W
<b>PLANTAINS (Plantaginaceae)</b>				
<i>Plantago lanceolata</i>	English plantain	May-Oct	A	W
<i>Plantago major</i>	common plantain	Jul-Sep	A	E,W
<i>Plantago rugelii</i>	black-seed or Rugel's plantain	Jul-Oct	N	W
<b>OLIVES (Oleaceae)</b>				
<i>Fraxinus americana</i>	white ash	Apr-Jun	N	E,W
<i>Fraxinus pennsylvanica</i> [= <i>F. p.</i> var. <i>subintegerrima</i> ]	green ash	May	N	E
<i>Ligustrum vulgare</i>	common or European privet	Jun	A	E,W
<b>FIGWORTS (Scrophulariaceae)</b>				
<i>Agalinis tenuifolia</i>	slender false-foxglove or gerardia	Jul-Sep	N	W
<i>Antirrhinum majus</i>	common snapdragon	Jun-Sep	A	E
<i>Aureolaria flava</i>	smooth false-foxglove	Jul-Sep	N	W
<i>Chaenorrhinum minus</i>	lesser toadflax	Jun-Sep	A	E
<i>Chelone glabra</i>	white turtlehead	Jul-Sep	N	E,W
<i>Gratiola neglecta</i>	clammy hedgehyssop	May-Oct	N	W
<i>Linaria vulgaris</i>	butter-and-eggs	Jul-Aug	A	E
<i>Lindernia dubia</i>	yellow-seed false-pimpernel	Jul-Sep	N	E
<i>Mimulus alatus</i>	sharp-wing monkey-flower	Jun-Aug	N	E,W
<i>Mimulus ringens</i>	Allegheny or common monkey-flower	Jun-Sep	N	E,W
<i>Pedicularis lanceolata</i>	swamp lousewort	Aug-Sep	N	E,W
<i>Penstemon hirsutus</i>	hairy beardtongue	May-Jul	N	E
<i>Scrophularia lanceolata</i>	lance-leaf or American figwort	May-Jul	N	E
<i>Scrophularia marilandica</i>	carpenter's square	Jun-Oct	N	W
<i>Verbascum blattaria</i>	moth mullein	Jun-Sep	A	W
<i>Verbascum thapsus</i>	common or woolly mullein	Jun-Sep	A	E,W
<i>Veronica anagallis-aquatica</i> [= <i>V. anagallis</i> ]	water speedwell	May-Oct	N	W
<i>Veronica arvensis</i>	corn speedwell	Apr-Sep	A	E,W
<i>Veronica officinalis</i>	common speedwell	May-Jul	A	W
<i>Veronica peregrina</i>	purslane speedwell	Mar-Aug	N	W
<i>Veronica polita</i>	slender speedwell	Mar-May	A	W
<i>Veronica serpyllifolia</i>	thyme-leaf speedwell	May-Aug	A	E,W
<i>Veronicastrum virginicum</i>	Culver's-root	Jun-Aug	N	E
<b>BROOM-RAPES (Orobanchaceae)</b>				
<i>Epifagus virginiana</i>	beech-drops	Aug-Oct	N	W

	Common Name	Phenology	Origin	Loc
<b>BIGNONIAS (Bignoniaceae)</b>				
<i>Campsis radicans</i>	trumpet creeper	Jul-Aug	Z	E,W
<i>Catalpa bignonioides</i>	southern catalpa	Jun-Jul	C	E
<i>Catalpa speciosa</i>	northern catalpa	May-Jun	Z	W
<b>BLUEBELLS (Campanulaceae)</b>				
<i>Lobelia cardinalis</i>	cardinal flower	Jul-Sep	N	E
<i>Lobelia inflata</i>	Indian-tobacco	Jul-Oct	N	E,W
<i>Lobelia siphilitica</i>	great blue lobelia	Aug-Sep	N	E,W
<i>Triodanis perfoliata</i> [= <i>Specularia p.</i> ]	clasping-leaf Venus'-looking-glass	May-Jun	N	E,W
<b>MADDERS (Rubiaceae)</b>				
<i>Cephalanthus occidentalis</i>	common buttonbush	Jun-Aug	N	E,W
<i>Galium aparine</i>	catchweed bedstraw, cleavers	May-Jul	N	E,W
<i>Galium asprellum</i>	rough bedstraw	May-Aug	N	E
<i>Galium circaezans</i>	forest bedstraw	Jun-Jul	N	E,W
<i>Galium lanceolatum</i>	wild licorice	Jun-Jul	N	W
<i>Galium mollugo</i>	wild madder	Jun-Aug	A	W
<i>Galium obtusum</i>	blunt-leaf bedstraw	May-Jul	N	W
<i>Galium tinctorium</i>	stiff marsh bedstraw	Jun-Aug	N	E
<i>Galium trifidum</i>	small bedstraw	Jul-Sep	N	W
<i>Galium triflorum</i>	sweet-scent bedstraw	Jun-Aug	N	E,W
<i>Houstonia caerulea</i> [= <i>Hedyotis caerulea</i> ]	innocence, bluets	Apr-Jun	N	E,W
<i>Mitchella repens</i>	partridge-berry	Jun-Jul	N	W
<b>HONEYSUCKLES (Caprifoliaceae)</b>				
<i>Lonicera dioica</i> var. <i>dioica</i>	mountain honeysuckle	May-Jun	N	E
<i>Lonicera dioica</i> var. <i>glaucescens</i>	wild honeysuckle	May-Jun	N	E
<i>Lonicera japonica</i>	Japanese honeysuckle	May-Sep	N	E,W
<i>Lonicera maackii</i>	amur honeysuckle		A	W
<i>Lonicera tatarica</i>	tartarian or bush honeysuckle	May-Jun	A	W
<i>Sambucus nigra</i> ssp. <i>canadensis</i> [= <i>S. canadensis</i> ]	American elder, common elderberry	Jun-Jul	N	E,W
<i>Sambucus racemosa</i>	European red elder	May-Jun	N	W
<i>Triosteum perfoliatum</i>	tinker's weed, perfoliate horse-gentian	May-Jul	N	E,W
<i>Viburnum acerifolium</i>	maple-leaf viburnum, dockmackie	May-Jun	N	E,W
<i>Viburnum dentatum</i>	arrow-wood	May-Jul	N	W
<i>Viburnum dentatum</i> var. <i>lucidum</i> [= <i>V. recognitum</i> ]	southern arrow-wood	May-Jul	N	E,W
<i>Viburnum lentago</i>	nannyberry	May-Jun	N	E,W
<i>Viburnum opulus</i>	guelder rose, Euro cranberry	Jun-Jul	A	E,W
<i>Viburnum prunifolium</i>	black-haw	Apr-May	N	E
<b>VALERIANS (Valerianaceae)</b>				
<i>Valerianella radiata</i>	beaked cornsalad	Apr-May	N	E,W
<i>Valerianella locusta</i> [= <i>V. olitoria</i> ]	European cornsalad	Apr-Jun	A	W
<i>Valerianella umbilicata</i>	navel-shape cornsalad	May-Jun	N	E
<i>Valerianella woodsiana</i>	Woods' cornsalad	May-Jun	N	W
<b>TEASELS (Dipsacaceae)</b>				
<i>Dipsacus fullonum</i> ssp. <i>sylvestris</i> [= <i>D. sylvestris</i> ]	teasel	Jul-Sep	A	E,W
<b>COMPOSITES (Asteraceae)</b>				
<i>Achillea millefolium</i>	common yarrow	Jun-Oct	N	E,W
<i>Ageratina altissima</i> [= <i>Eupatorium rugosum</i> ; <i>E. ageratoicles</i> ]	white snakeroot	Jul-Oct	N	E,W
<i>Ambrosia artemisiifolia</i>	annual or common ragweed	Aug-Sep	N	E,W
<i>Ambrosia trifida</i>	great or giant ragweed	Jul-Oct	N	E,W
<i>Antennaria neglecta</i>	field pussytoes	Apr-Jul	N	W
<i>Antennaria parlinii</i>	Parlin's everlasting pusseytoes	Apr-Jun	N	W
<i>Antennaria plantaginifolia</i>	plantain pussytoes	Apr-Aug	N	E

COMPOSITES (cont'd)	Common Name	Phenology	Origin	Loc
<i>Arctium minus</i>	common burdock	Jul-Oct	A	E,W
<i>Arnoglossum atriplicifolium</i> [= <i>Cacalia atriplicifolia</i> ]	pale Indian-plantain	Jul-Sep	N	E
<i>Artemisia campestris</i>	beach wormwood	Jul-Sep	N(T)	E
<i>Artemisia campestris</i> ssp. <i>caudata</i>	wormwood [= <i>A. caudata</i> ]	Jul-Sep	N	E
<i>Artemisia vulgaris</i>	mugwort	Jul-Aug	A	W
<i>Aster boreaus</i> [= <i>A. junciformis</i> ]	rush aster	Jun-Sep	N	W
<i>Aster cordifolius</i>	common blue heart-leaved aster	Aug-Oct	N	E,W
<i>Aster cordifolius</i> var. <i>sagittifolius</i> [= <i>A. sagittifolius</i> ]	arrow-leaved aster	Aug-Oct	N	E,W
<i>Aster dumosus</i>	bush aster	Aug-Oct	N(T)	E
<i>Aster ericoides</i>	white heath aster	Jul-Oct	N	E
<i>Aster laevis</i>	smooth aster	Aug-Oct	N	E
<i>Aster lanceolatus</i> [= <i>A. paniculatus</i> ; <i>A. simplex</i> ]	panicled aster	Aug-Oct	N	E,W
<i>Aster lateriflorus</i> [= <i>A. vimineus</i> ]	calico aster	Aug-Oct	N	E,W
<i>Aster longifolius</i> [= <i>A. junceus</i> ]	New York aster	Jul-Oct	N	W
<i>Aster macrophyllus</i>	big-leaf aster	Aug-Sep	N	W
<i>Aster novae-angliae</i>	New England aster	Aug-Oct	N	E,W
<i>Aster oolentangiensis</i> [= <i>A. azureus</i> ]	prairie heart-leaved aster	Aug-Oct	N	E
<i>Aster pilosus</i>	awl aster	Aug-Oct	N	W
<i>Aster pilosus</i> var. <i>demotus</i> [= <i>A. racemosus</i> ]	coastal-plain aster	Oct	N	E,W
<i>Aster praealtus</i>	willow-leaf aster	Sep-Oct	N	E
<i>Aster prenanthoides</i>	crooked-stem aster	Aug-Oct	N	W
<i>Aster shortii</i>	midwestern blue heart-leaved aster	Aug-Oct	N	E
<i>Aster undulatus</i>	clasping heart-leaved aster	Aug-Oct	N	E
<i>Bidens cernua</i>	nodding beggar-ticks	Sep-Oct	N	E,W
<i>Bidens connata</i>	purple-stem beggar-ticks	Sep-Oct	N	E
<i>Bidens frondosa</i>	devil's beggar-ticks	Sep-Oct	N	E,W
<i>Bidens laevis</i>	smooth beggar-ticks, tickseed	Aug-Nov	N	E
<i>Bidens vulgata</i>	tall beggar-ticks	Aug-Oct	N	W
<i>Cichorium intybus</i>	chicory	Jun-Oct	A	E,W
<i>Cirsium arvense</i>	creeping thistle	Jul-Oct	A	E,W
<i>Cirsium muticum</i>	swamp thistle	Jul-Sep	N	W
<i>Cirsium vulgare</i>	bull thistle	Jul-Sep	A	E,W
<i>Conyza canadensis</i> [= <i>Erigeron canadensis</i> ]	horseweed	late summer- autumn	N	E,W
<i>Coreopsis tripteris</i>	tall tickseed	Jul-Sep	N	E,W
<i>Eclipta prostrata</i> [= <i>E. alba</i> ]	yerba de tajo, pie-plate-plant	Aug-Oct	N	E
<i>Erechtites hieraciifolia</i>	American burn, pilewort	Jul-Oct	N	W
<i>Erigeron annuus</i>	white-top fleabane	Jun-Oct	N	E,W
<i>Erigeron philadelphicus</i>	Philadelphia or daisy fleabane	Apr-May	N	E,W
<i>Erigeron strigosus</i>	prairie fleabane	Jun-Aug	N	E,W
<i>Eupatorium altissimum</i>	tall eupatorium	Jul-Sep	N	E
<i>Eupatorium maculatum</i>	spotted Joe-pye-weed	Jul-Sep	N	E,W
<i>Eupatorium perfoliatum</i>	common boneset	Jul-Oct	N	E,W
<i>Eupatorium pilosum</i>	hairy thoroughwort	Aug-Sep	N	E
<i>Eupatorium purpureum</i>	sweet Joe-pye-weed	Jul-Sep	N	W
<i>Euthamia graminifolia</i>	flat-top fragrant-golden-rod	Jul-Oct	N	E,W
<i>Euthamia tenuifolia</i>	narrow-leaf fragrant-golden-rod	Aug-Oct	N	E
<i>Galinsoga parviflora</i>	lesser quickweed or galinsoga	Jun-Oct	A	E,W
<i>Galinsoga quadriradiata</i>	common quickweed or galinsoga	Jun-Nov	A	W
<i>Helenium autumnale</i>	common sneezeweed	Aug-Oct	N	E
<i>Helianthus annuus</i>	common or garden sunflower	Jul-Oct	C	W
<i>Helianthus divaricatus</i>	divaricate sunflower	Jul-Oct	N	E
<i>Helianthus hirsutus</i>	hairy sunflower	Jul-Oct	N	E
<i>Helianthus strumosus</i>	rough-leaved sunflower	Jul-Sep	N	E
<i>Helianthus tuberosus</i>	Jerusalem artichoke	Aug-Oct	N	E,W

COMPOSITES (cont'd)	Common Name	Phenology	Origin	Loc
<i>Heliopsis helianthoides</i>	ox-eye, sunflower-everlasting	Jul-Oct	N	E
<i>Hieracium aurantiacum</i>	orange-red king-devil or hawkweed	Jun-Sep	A	E,W
<i>Hieracium caespitosum</i> [= <i>H. pratense</i> ]	yellow king-devil, field hawkweed	May-Sep	A	E,W
<i>Hieracium paniculatum</i>	panicked hawkweed	Jul-Sep	N	W
<i>Hieracium pilosella</i>	mouse-ear hawkweed	Jun-Sep	A	W
<i>Hieracium venosum</i>	veiny hawkweed	May-Jul	N	E
<i>Hieracium x floribundum</i>	smoothish hawkweed	Jun-Aug	A	W
<i>Krigia biflora</i>	two-flower dwarf-dandelion, Cynthia	May-Oct	N	E
<i>Lactuca biennis</i>	biennial or tall blue lettuce	Jul-Oct	N	W
<i>Lactuca canadensis</i>	tall yellow or wild lettuce	Jul-Sep	N	E,W
<i>Lactuca floridana</i>	woodland lettuce	Jun-Sep	N	E
<i>Lactuca serriola</i>	prickly lettuce	Jul-Sep	A	W
<i>Leucanthemum vulgare</i> [= <i>Chrysanthemum leucanthemum</i> ]	oxeye daisy	Jun-Aug	A	W
<i>Liatris spicata</i>	spiked gayfeather, blazing star	Jul-Sep	N	E,W
<i>Matricaria discoidea</i>	pineapple-weed	May-Sep	Z	W
<i>Oligoneuron ohioense</i> [= <i>Solidago ohioensis</i> ]	Ohio golden-rod	Aug-Sep	N(P)	E
<i>Picris hieracioides</i>	hawkweed oxtongue, bitterweed	Jul-Sep	A	W
<i>Prenanthes alba</i>	white rattlesnake-root or lettuce	Aug-Sep	N	E,W
<i>Prenanthes serpentaria</i>	lion's foot	Aug-Oct	N	E
<i>Rudbeckia fulgida</i>	orange coneflower	Jul-Oct	N	E
<i>Rudbeckia hirta</i>	black-eyed Susan	Jun-Oct	N	E,W
<i>Rudbeckia laciniata</i>	cut-leaf or greenheaded coneflower	Jul-Sep	N	E,W
<i>Senecio aureus</i>	golden ragwort	Apr-Aug	N	E,W
<i>Senecio glabellus</i>	grass-leaf groundsel	May-Jul	N	E
<i>Senecio obovatus</i> [= <i>S. rotundus</i> ]	round-leaf groundsel	Apr-Jun	N	E,W
<i>Senecio vulgaris</i>	common groundsel	May-Oct	A	W
<i>Silphium perfoliatum</i>	cup-plant	Jul-Sep	N	W
<i>Silphium trifoliatum</i>	whorled rosinweed	Jul-Sep	N	E,W
<i>Solidago caesia</i>	wreath golden-rod	Aug-Oct	N	E,W
<i>Solidago canadensis</i>	Canada golden-rod	Jul-Sep	N	E,W
<i>Solidago flexicaulis</i> [= <i>S. latifolia</i> ]	zigzag golden-rod	Jul-Oct	N	W
<i>Solidago gigantea</i>	giant golden-rod	Aug-Oct	N	E
<i>Solidago juncea</i>	early golden-rod	Jul-Sep	N	E
<i>Solidago nemoralis</i>	gray golden-rod	Jul-Nov	N	W
<i>Solidago patula</i>	rough-leaf golden-rod	Aug-Oct	N	W
<i>Solidago rugosa</i>	wrinkled golden-rod	Aug-Oct	N	E,W
<i>Solidago speciosa</i>	showy golden-rod	Aug-Oct	N	E
<i>Solidago ulmifolia</i>	elm-leaved golden-rod	Aug-Oct	N	E
<i>Sonchus arvensis</i>	field sowthistle	Jul-Oct	A	W
<i>Sonchus asper</i>	prickly sowthistle	Jun-Oct	A	E,W
<i>Sonchus oleraceus</i>	common sowthistle	Jun-Oct	A	W
<i>Taraxacum officinale</i>	common dandelion	Mar-Dec	A	E,W
<i>Tragopogon porrifolius</i>	salsify	May-Jul	A	W
<i>Tragopogon pratensis</i>	goats-beard	Jun-Oct	A	W
<i>Tussilago farfara</i>	colts-foot	Mar-May	A	W
<i>Verbesina alternifolia</i> [= <i>Actinomeris alternifolia</i> ]	wingstem	Aug-Oct	N	E,W
<i>Verbesina occidentalis</i> [= <i>Actinomeris occidentalis</i> ]	southern flatseed-sunflower, yellow crownbeard	Jun-Oct	N(E)	E
<i>Vernonia gigantea</i> [= <i>V. altissima</i> ]	tall ironweed	Aug-Oct	N	E,W
<i>Xanthium strumarium</i> [= <i>Solidago tenuifolia</i> ]	rough cockle-bur	Aug-Sep	N	E,W
<b>FLOWERING RUSHES (Butomaceae)</b>				
<i>Butomus umbellatus</i>	flowering-rush	Jun-Sep	A	E



	Common Name	Phenology	Origin	Loc
<b>WATER-PLANTAINS (Alismataceae)</b>				
<i>Alisma subcordatum</i>	subcordate water-plantain	Jun-Sep	N	E
<i>Alisma triviale</i> [= <i>A. plantago-aquatica</i> var. <i>americanum</i> ]	broad-leaf water-plantain	Jun-Sep	N(T)	E
<i>Sagittaria latifolia</i>	broad-leaf arrow-head	Jul-Sep	N	E,W
<b>FROG'S-BITES (Hydrocharitaceae)</b>				
<i>Elodea canadensis</i>	broad water-weed	Jul-Sep	N	E,W
<b>PONDWEEDS (Potamogetonaceae)</b>				
<i>Potamogeton crispus</i>	curly pondweed	May-Sep	A	E
<i>Potamogeton foliosus</i>	leafy pondweed	Jul-Oct	N	E
<i>Potamogeton nodosus</i>	long-leaf pondweed	Aug-Sep	N	E
<i>Potamogeton pectinatus</i>	sago pondweed	Jul-Aug	N	E
<b>SWEETFLAGS (Acoraceae)</b>				
<i>Acorus americanus</i>	sweetflag	May-Jun	N	E,W
<i>Acorus calamus</i>	sweetflag	May-Jun	N	E
<b>ARUMS (Araceae)</b>				
<i>Arisaema dracontium</i>	green dragon	May-Jun	N	W
<i>Arisaema triphyllum</i> [= <i>A. atrorubens</i> ]	swamp Jack-in-the-pulpit	Apr-Jun	N	E,W
<i>Peltandra virginica</i>	arrow arum	May-Jun	N	E
<i>Symplocarpus foetidus</i>	skunk-cabbage	Mar-Apr	N	E,W
<b>DUCKWEEDS (Lemnaceae)</b>				
<i>Lemna minor</i>	lesser duckweed	Jun-Aug	N	E,W
<i>Spirodela polyrrhiza</i>	greater duckweed	Jun-Aug	A	E
<i>Wolffia columbiana</i>	Columbia water-meal, wolffia		N	E,W
<b>SPIDERWORTS (Commelinaceae)</b>				
<i>Commelina communis</i>	Asiatic dayflower	Jun-Oct	A	E,W
<i>Tradescantia virginiana</i>	Virginia spider-wort	spring	N	E
<b>RUSHES (Juncaceae)</b>				
<i>Juncus acuminatus</i>	taper-tip rush	May-Aug	N	E
<i>Juncus biflorus</i>	turnflower rush	May-Sep	N	W
<i>Juncus canadensis</i>	Canada rush	Jul-Oct	N	W
<i>Juncus effusus</i>	soft rush	Aug	N	E,W
<i>Juncus marginatus</i>	grass-leaf rush	Jun-Sep	N	W
<i>Juncus nodosus</i>	knotted rush	Jul-Aug	N	W
<i>Juncus tenuis</i>	slender or path rush	May-Jul	N	E,W
<i>Juncus torreyi</i>	Torrey's rush	Jul-Oct	N	W
<i>Luzula multiflora</i>	common woodrush	Apr-Jul	N	E
<b>SEDGES (Cyperaceae)</b>				
<i>Bolboschoenus fluviatilis</i> [= <i>Scirpus fluviatilis</i> ]	river bulrush	Jun-Aug	N	E
<i>Bulbostylis capillaris</i> [= <i>Fimbristylis capillaris</i> ]	dense-tuft hairsedge	Aug-Oct	N	W
<i>Carex albicans</i> [= <i>C. artitecta</i> ]	closely-covered sedge	May-Aug	N	E
<i>Carex albursina</i> [= <i>C. laxiflora</i> var. <i>latifolia</i> ]	loose-flowered sedge	Apr-Jun	N	W
<i>Carex amphibola</i> var. <i>turgida</i> [= <i>C. grisea</i> ]	narrow-leaf sedge	May-Jul	N	E,W
<i>Carex annectens</i>	yellow-fruit sedge	May-Jul	N	E
<i>Carex aquatilis</i>	water or leafy tussock sedge	Jul-Aug	N(T)	E
<i>Carex arcuata</i>	northern clustered sedge	Jun-Aug	N(E)	W
<i>Carex atherodes</i>	slough sedge	Jun-Aug	N(P)	E
<i>Carex bebbii</i>	Bebb's sedge	Jun-Aug	N(P)	E
<i>Carex bicknellii</i>	Bicknell's sedge	May-Jul	N(T)	E,W
<i>Carex blanda</i>	woodland sedge	Apr-Jun	N	E,W
<i>Carex brevior</i>	shorter sedge	May-Jul	N	E
<i>Carex bromoides</i>	brome-like sedge	May-Jul	N	W

SEDGES (cont'd)	Common Name	Phenology	Origin	Loc
<i>Carex cephalophora</i>	oval-leaf sedge	May-Jul	N	E
<i>Carex comosa</i>	bearded or longhair sedge	Jun-Aug	N	E
<i>Carex complanata</i>	hirsute sedge	May-Jul	N	E
<i>Carex conjuncta</i>	soft fox sedge	Jun	N	W
<i>Carex crinita</i>	fringed sedge	May-Aug	N	E,W
<i>Carex crus-corvi</i>	raven-foot sedge	Jun-Jul	N(E)	E
<i>Carex davisii</i>	Davis' sedge	May-Jun	N	W
<i>Carex digitalis</i>	finger sedge	May-Jul	N	E,W
<i>Carex echinata</i> [= <i>C. cephalantha</i> ]	little prickly sedge	Jul-Sep	N(E)	E
<i>Carex frankii</i>	Frank's sedge	Jun-Jul	N	E,W
<i>Carex glaucoidea</i> [= <i>C. flaccosperma</i> var. <i>glaucoidea</i> ]	thin-fruit sedge	May-Jul	N	W
<i>Carex granularis</i>	meadow sedge	May-Jul	N	W
<i>Carex grayi</i>	Asa Gray's sedge	Jun-Oct	N	E,W
<i>Carex hirsutella</i>	slightly hirsute sedge	May-Jul	N	E
<i>Carex hirtifolia</i>	hairy-leaved sedge	May-Jun	N	W
<i>Carex intumescens</i>	bladder sedge	May-Sep	N	E,W
<i>Carex jamesii</i>	James' sedge	May-Jun	N	W
<i>Carex lacustris</i>	lakebank sedge	May-Aug	N	E
<i>Carex lasiocarpa</i>	woolly-fruit sedge	May-Aug	N(P)	E,W
<i>Carex laxiculmis</i> [= <i>C. digitalis copulata</i> ]	loose-culmed sedge	May-Jul	N	W
<i>Carex laxiflora</i> [= <i>C. laxiflora patulifolia</i> ]	loosely-flowered sedge	Apr-Jun	N	W
<i>Carex lupulina</i>	hop sedge	Jun-Oct	N	E,W
<i>Carex lurida</i>	shallow sedge	Jun-Oct	N	W
<i>Carex normalis</i>	larger straw sedge	May-Aug	N	W
<i>Carex oligocarpa</i>	few-fruited sedge	May-Jul	N	W
<i>Carex pallescens</i>	rather pale sedge	May-Aug	N(T)	W
<i>Carex pedunculata</i>	peduncled sedge	Apr-May	N	W
<i>Carex pennsylvanica</i>	Pennsylvania sedge	Apr-Jun	N	E,W
<i>Carex projecta</i>	necklace sedge	Jun-Aug	N(T)	W
<i>Carex radiata</i>	radiate sedge	May-Aug	N(P)	E
<i>Carex retroflexa</i>	reflexed sedge	May-Jun	N(P)	E
<i>Carex rosea</i> [= <i>C. convoluta</i> ]	rose-like sedge	May-Jul	N	E,W
<i>Carex scoparia</i>	pointed broom sedge	May-Aug	N	W
<i>Carex shortiana</i>	Short's sedge	May-Jun	N	W
<i>Carex squarrosa</i>	squarrose sedge	Jun-Sep	N	E,W
<i>Carex stipata</i>	awl-fruited sedge	May-Aug	N	E,W
<i>Carex straminea</i> [= <i>C. straminea mirabilis</i> ]	straw sedge	May-Jul	N(P)	W
<i>Carex striatula</i> [= <i>C. laxiflora</i> var. <i>angustifolia</i> ]	lined sedge	May-Jun	N(E)	W
<i>Carex tribuloides</i>	blunt broom sedge	Jun-Sep	N	E
<i>Carex typhina</i> [= <i>C. typhinoides</i> ]	cat-tail sedge	Jun-Sep	N	W
<i>Carex vesicaria</i> var. <i>monile</i> [= <i>C. monile</i> ]	inflated sedge	Jun-Aug	N	W
<i>Carex virescens</i> [= <i>C. virescens</i> var. <i>costata</i> ]	greenish sedge	May-Jul	N	W
<i>Carex vulpinoidea</i>	fox sedge	Jun-Jul	N	E,W
<i>Cyperus bipartitus</i> [= <i>C. rivularis</i> ]	shining flatsedge	Sep	N	E
<i>Cyperus erythrorhizus</i>	red-root flatsedge, umbrella-sedge	Aug-Oct	N	E
<i>Cyperus esculentus</i>	chufa	Sep	N	E,W
<i>Cyperus filiculmis</i>	slender flatsedge, nutsedge	Aug-Oct	N	W
<i>Cyperus odoratus</i> [= <i>C. ferruginescens</i> ; <i>C. engelmannii</i> ]	rusty or Englemann flatsedge	Aug-Sep	N	E
<i>Cyperus schweinitzii</i>	Schweinitz's flatsedge	Jul-Sep	N(P)	W
<i>Cyperus strigosus</i>	straw-color flatsedge, galingale	Sep	N	E
<i>Eleocharis obtusa</i>	blunt spikerush	May-Oct	N	W
<i>Eleocharis ovata</i>	ovate spikerush	Aug-Oct	N(E)	E
<i>Rhynchospora glomerata</i> [= <i>R. cymosa</i> ]	clustered beakrush	Jul-Oct	N	W
<i>Schoenoplectus pungens</i> [= <i>Scirpus americanus</i> ; <i>S. pungens</i> ]	three-square bulrush	Jul-Aug	N	E

SEDGES (cont'd)	Common Name	Phenology	Origin	Loc
<i>Schoenoplectus tabernaemontani</i> [= <i>Scirpus validus</i> ; <i>S. v. var. creber</i> ]	soft-stem or great bulrush	Jul-Aug	N	E,W
<i>Scirpus atrovirens</i>	green bulrush	Jun-Aug	N	E,W
<i>Scirpus cyperinus</i>	wool-grass	Jun-Sep	N	E,W
<i>Scirpus pedicellatus</i>	stalked bulrush	Jul-Aug	N	E
<i>Scirpus polyphyllus</i>	leafy bulrush	Jul-Sep	N	W
<i>Scleria pauciflora</i>	few-flower nutrush	Jun-Sep	N(T)	W
<i>Scleria triglomerata</i>	whip nutrush	Jun-Sep	N(P)	W
<b>GRASSES (Poaceae)</b>				
<i>Aegilops cylindrica</i>	jointed goat-grass	Jul-Sep	A	E
<i>Agrostis stolonifera</i>	spreading bentgrass	Jun-Sep	N	E
<i>Ammophila breviligulata</i>	American beachgrass	Jul-Sep	N(T)	W
<i>Andropogon gerardii</i>	big bluestem	Aug-Sep	N	E
<i>Andropogon virginicus</i>	broom-sedge		N	W
<i>Brachyelytrum erectum</i>	erect grass	Jun-Aug	N	W
<i>Bromus arvensis</i>	field chess	Jun-Jul	A	W
<i>Bromus hordeaceus</i> [= <i>B. mollis</i> ]	soft chess	May-Jul	A	W
<i>Bromus japonicus</i>	Japanese brome	Jul-Aug	A	E
<i>Bromus kalmii</i>	Kalm's brome	Jun-Aug	N	E
<i>Calamagrostis canadensis</i>	blue-joint reedgrass	Jun-Sep	N	E
<i>Cenchrus incertus</i> [= <i>C. pauciflorus</i> ]	few-flower sandbur	Jul-Oct	A	E
<i>Cinna arundinacea</i>	stout wood-reed grass	Aug	N	E
<i>Dactylis glomerata</i>	orchard grass	May-Sep	A	W
<i>Danthonia compressa</i>	flattened oatgrass	Jun-Aug	N(P)	W
<i>Danthonia spicata</i>	poverty oatgrass	May-Jul	N	W
<i>Dichanthelium acuminatum</i> var. <i>fasciculatum</i> [= <i>Panicum lanuginosum</i> ; <i>P. l. var. implicatum</i> ]	panic grass	Jun-Sep; Jul-Nov	N	E,W
<i>Dichanthelium depauperatum</i> [= <i>Panicum depauperatum</i> ]	impoverished panic grass	May-Aug; Jul-Oct	N(E)	W
<i>Dichanthelium dichotomum</i> [= <i>Panicum dichotomum</i> ; <i>P. barbdatum</i> ]	cypress witchgrass	May-Jul; Jun-Nov	N	W
<i>Digitaria ischaemum</i>	small crabgrass	Jul-Oct	A	W
<i>Digitaria sanguinalis</i>	hairy crabgrass	Sep-Oct	A	E,W
<i>Echinochloa crus-galli</i>	barnyard grass	Sep	A	E,W
<i>Echinochloa muricata</i> [= <i>E. pungens</i> ]	rough barnyard grass	Jul-Sep	N	E
<i>Echinochloa walteri</i>	coast cockspur, Walter's millet	Sep	N	E
<i>Eleusine indica</i>	India goosegrass	Jul-Oct	A	W
<i>Elymus canadensis</i>	nodding wild-rye	Jul-Oct	N	E
<i>Elymus caninus</i> [= <i>Agropyron caninum</i> ]	cutting wheatgrass	Jun-Aug	A	W
<i>Elymus hystrix</i> [= <i>Hystrix patula</i> ]	bottlebrush grass	Jun-Aug	N	E,W
<i>Elymus trachycaulus</i> ssp. <i>subsecundus</i> [= <i>Agropyron trachycaulum</i> var. <i>glaucum</i> ]	slender wheatgrass	Jun-Aug	N	W
<i>Elymus villosus</i>	hairy wild-rye	Jun-Aug	N	E
<i>Elymus virginicus</i>	Virginia wild-rye	Jul-Sep	N	E,W
<i>Elytrigia repens</i> [= <i>Agropyron repens</i> ]	quackgrass	Jun-Aug	A	W
<i>Eragrostis pectinacea</i>	purple lovegrass	Aug-Sep	N	E,W
<i>Glyceria striata</i>	fowl manna grass	May-Sep	N	E,W
<i>Leersia oryzoides</i>	rice cutgrass	Aug	N	E,W
<i>Leersia virginica</i>	whitegrass	Jul-Oct	N	E,W
<i>Lolium pratense</i> [= <i>Festuca elatior</i> ]	tall fescue	Jun-Aug	A	W
<i>Muhlenbergia schreberi</i>	nimble will	Jul-Nov	N	W
<i>Nardus stricta</i>	mat grass	Jun-Sep	A	E
<i>Panicum capillare</i>	witchgrass	Sep	N	E,W
<i>Panicum virgatum</i>	switchgrass	Jul-Sep	N	E
<i>Phalaris arundinacea</i>	reed canary grass	Jun-Sep	Z	E,W
<i>Phleum pratense</i>	timothy	Jul-Aug	A	E,W

GRASSES (cont'd)	Common Name	Phenology	Origin	Loc
<i>Phragmites australis</i>	common reed	Jul-Sep	Z	E,W
<i>Poa compressa</i>	Canada bluegrass	May-Sep	A	E,W
<i>Poa pratensis</i>	Kentucky bluegrass	May-Aug	Z	E,W
<i>Poa sylvestris</i>	woodland bluegrass	Apr-Jun	N	E
<i>Poa trivialis</i>	rough bluegrass	Jun-Aug	A	W
<i>Schizachyrium scoparium</i> [= <i>Andropogon scoparius</i> ]	little bluestem	Sep-Oct	N	E
<i>Setaria faberi</i>	Faber's fox-tail grass	Aug-Sep	A	E,W
<i>Setaria glauca</i>	yellow bristle grass	Sep	A	E,W
<i>Sorghastrum nutans</i>	Indian grass	Sep	N	E
<i>Sorghum halepense</i>	Johnson grass	Jul-Sep	A	E
<i>Tridens flavus</i> [= <i>Triodia flava</i> ]	purple-top tridens	Aug-Oct	N	W
<i>Triplasis purpurea</i>	purple sand-grass	Aug-Oct	N(P)	E
<i>Vulpia octoflora</i> var. <i>glauca</i> [= <i>Festuca tenella</i> ]	six-weeks fescue	May-Jun	N	W
<b>BUR-REEDS (Sparganiaceae)</b>				
<i>Sparganium americanum</i>	American bur-reed	Jun-Sep	N	W
<i>Sparganium eurycarpum</i>	giant bur-reed	Jun-Sep	N	E
<b>CATTAILS (Typhaceae)</b>				
<i>Typha angustifolia</i>	narrow-leaf cattail	May-Jul	Z	E,W
<i>Typha x glauca</i>	blue cattail	May-Jul	N	E
<i>Typha latifolia</i>	broad-leaf or common cattail	May-Jul	N	E,W
<b>PICKERELWEEDS (Pontederiaceae)</b>				
<i>Pontederia cordata</i>	pickerel weed	Jun-Oct	N	E
<b>LILIES (Liliaceae)</b>				
<i>Allium canadense</i>	meadow onion	May-Jul	N	E,W
<i>Allium sativum</i>	garlic	May-Jun	A	E
<i>Allium tricoccum</i>	small white leek	Jun-Jul	N	W
<i>Allium vineale</i>	field garlic	May-Jul	A	W
<i>Asparagus officinalis</i>	garden asparagus-fern	May-Jun	A	E,W
<i>Camassia scilloides</i>	Atlantic camassia, wild hyacinth	May-Jun	N	W
<i>Chamaelirium luteum</i> [= <i>C. carolinianum</i> ]	fairy-wand, blazing-star	May-Jul	N	W
<i>Convallaria majalis</i>	lily-of-the-valley	Apr-Jun	C	W
<i>Disporum lanuginosum</i>	fairy bells, yellow mandarin	May-Jun	N	W
<i>Erythronium albidum</i>	white fawnlily or trout-lily	Mar-May	N	E,W
<i>Erythronium americanum</i>	yellow fawnlily or trout-lily	Mar-May	N	E,W
<i>Hemerocallis fulva</i>	common orange day-lily	Jun-Aug	C	E,W
<i>Hypoxis hirsuta</i>	eastern yellow stargrass	Jun-Sep	N	E
<i>Lilium canadense</i>	Canada lily	Jun-Aug	N	E
<i>Lilium michiganense</i>	Michigan lily	Jun-Jul	N	E
<i>Lilium</i> sp.	lily	Jun-Sep	N	W
<i>Maianthemum canadense</i> [= <i>M. convallaria</i> ]	wild-lily-of-the-valley or Canada mayflower	May-Jul	N	W
<i>Maianthemum racemosum</i> [= <i>Smilacina racemosa</i> ]	feather false-Solomon's-seal	May-Jul	N	E,W
<i>Medeola virginiana</i>	Indian cucumber-root	MayJun	N	W
<i>Ornithogalum umbellatum</i>	common star of Bethlenem	Apr-Jun	A	W
<i>Polygonatum biflorum</i>	small Solomon's-seal	Apr-Jun	N	E
<i>Polygonatum pubescens</i>	hairy Solomon's-seal	May-Jun	N	W
<i>Trillium flexipes</i>	white or drooping trillium	Apr-Jun	N	E,W
<i>Trillium grandiflorum</i>	large- or grand-flowered trillium	Apr-May	N	E,W
<i>Uvularia grandiflora</i>	large flowered bellwort	Apr-Jun	N	W
<i>Uvularia sessilifolia</i>	sessile-leaf bellwort, merry-bells	May-Jun	N	W
<b>IRISES (Iridaceae)</b>				
<i>Iris pseudacorus</i>	yellow iris	May-Jul	A	E,W
<i>Iris versicolor</i>	blueflag	May-Jul	N	E,W

<b>IRISES (cont'd)</b>	<b>Common Name</b>	<b>Phenology</b>	<b>Origin</b>	<b>Loc</b>
<i>Sisyrinchium albidum</i>	blue-eye-grass	May-Jun	N	E
<i>Sisyrinchium mucronatum</i> [= <i>S. montanum</i> misapplied]	Michaux's blue-eye-grass	May-Jun	N(E)	E
<i>Sisyrinchium</i> sp.	blue-eye-grass	May		W
<b>CATBRIERS (Smilacaceae)</b>				
<i>Smilax ecirrata</i>	erect carrion-flower	May	N	W
<i>Smilax herbacea</i>	smooth carrion-flower	May-Jun	N	W
<i>Smilax rotundifolia</i>	common greenbrier	Apr-Jun	N	W
<i>Smilax tamnoides</i> [= <i>S. hispida</i> ]	bristly greenbrier	May-Jul	N	E,W
<b>YAMS (Dioscoreaceae)</b>				
<i>Dioscorea quaternata</i>	four-leaf yam	May	N	E
<i>Dioscorea villosa</i>	yellow or wild yam	Jun-Jul	N	E,W
<b>ORCHIDS (Orchidaceae)</b>				
<i>Coeloglossum viride</i>	long-bract-green orchid	Jun-Aug	N(E)	W
<i>Epipactis helleborine</i> [= <i>E. latifolia</i> ]	helleborine	Jul-Sep	A	E
<i>Galearis spectabilis</i> [= <i>Orchis spectabilis</i> ]	showy orchis	Apr-Jun	N	W
<i>Goodyera pubescens</i>	downy rattlesnake-plantain	Jul-Aug	N	W
<i>Pogonia ophioglossoides</i> [= <i>P. pendula</i> ]	rose pogonia	Jun-Aug	N(T)	W
<i>Spiranthes cernua</i>	nodding ladies'-tresses	Aug-Sep	N	E
<i>Spiranthes magnicamporum</i>	great plains ladies'-tresses	Sep-Oct	N(P)	E
<i>Spiranthes ochroleuca</i>	ladies'-tresses	Aug-Sep	N	W
<i>Triphora trianthophora</i>	three-birds orchid	Jul-Sep	N(T)	W

Origin (and Status) Codes:

- A – Alien species
- C – Escaped from cultivation
- N – Native species
- Z – Native to North America,  
but later naturalized to Old Woman Creek watershed
- (E) – Endangered (Ohio)
- (P) – Potentially threatened (Ohio)
- (T) – Threatened (Ohio)

Location Codes:

- E - Estuary
- W- Watershed

**APPENDIX C. INVERTEBRATE FAUNA OF OLD WOMAN CREEK  
ESTUARY, WATERSHED, AND ADJACENT WATERS OF LAKE ERIE**

**PHYLUM SARCOMASTIGOPHORA (PROTOZOA)**

**Subphylum Mastigophora**

**CLASS DINOFLAGELLATA**

**Order Gymnodinida**

*Gymnodinium fungiforme*

**CLASS PHYTOMASTIGOPHORA**

**Order Cryptomonadida**

*Chilomonas* sp.

*Chroomonas norstedtii*

*Cryptomonas compressa*

*Cryptomonas erosa*

*Cryptomonas ovata*

*Cryptomonas ovata*

*Cryptomonas reflexa*

*Cryptomonas tenuis*

*Cyathomonas truncata*

*Planonephros parvula* [= *Sennia parvula*]

*Rhodomonas lacustris*

*Rhodomonas lens*

*Rhodomonas minuta*

**Order Chryomonadida**

*Anthophysa steinii*

*Anthophysa vegetans*

*Chromulina nana*

*Dinobryon bavaricum*

*Dinobryon sertularia*

*Mallomonas elegans*

*Mallomonas intermedia*

*Microglena* sp.

*Monas guttula*

*Monas socialis*

*Ochromonas ludibunda*

*Oikomonas termo*

*Physomonas vestita*

*Spumella* sp.

*Stokesiella* sp.

**Order Volvocida**

*Carteria globosa*

*Chlamydomonas excavata*

*Chlamydomonas globosa*

*Chlamydomonas gracilis*

*Chlamydomonas monadina*

*Chlamydomonas reinhardtii*

*Chlamydomonas subasymmetrica*

*Chlorogonium elongatum*

*Chlorogonium euchlorum*

*Chlorogonium hyalinum*

*Pandorina morum*

*Phacotus lenticularis*

*Pteromonas* sp.

	<b>Common Name</b>	<b>Family</b>	<b>Location</b>
	dinoflagellate	Gymnodiniidae	ES
	cryptomonad protozoan	Cryptomonadidae	ES
	cryptomonad protozoan	Cryptomonadidae	ES
	cryptomonad protozoan	Cryptomonadidae	ES
	cryptomonad protozoan	Cryptomonadidae	ES
	cryptomonad protozoan	Cryptomonadidae	ES
	cryptomonad protozoan	Cryptomonadidae	ES
	cryptomonad protozoan	Cryptomonadidae	ES
	cryptomonad protozoan	Cryptomonadidae	ES
	cryptomonad protozoan	Hemiselmidae	ES
	cryptomonad protozoan	Cryptomonadidae	ES
	cryptomonad protozoan	Cryptomonadidae	ES
	cryptomonad protozoan	Cryptomonadidae	ES
	chrysomonad protozoan	Anthophysidae	ES
	chrysomonad protozoan	Anthophysidae	ES
	chrysomonad protozoan	Chromulinidae	ES
	chrysomonad protozoan	Dinobryonidae	ES
	chrysomonad protozoan	Dinobryonidae	ES
	chrysomonad protozoan	Mallomonadidae	ES
	chrysomonad protozoan	Mallomonadidae	ES
	chrysomonad protozoan	Chrysococcidae	ES
	chrysomonad protozoan	Ochromonadidae	ES
	chrysomonad protozoan	Ochromonadidae	ES
	chrysomonad protozoan	Ochromonadidae	ES
	chrysomonad protozoan	Chromulinidae	ES
	chrysomonad protozoan	Ochromonadidae	ES
	chrysomonad protozoan	Ochromonadidae	ES
	chrysomonad protozoan	Dinobryonidae	ES
	volvocean protozoan	Carteriidae	ES
	volvocean protozoan	Chlamydomonadidae	ES
	volvocean protozoan	Chlamydomonadidae	ES
	volvocean protozoan	Chlamydomonadidae	ES
	volvocean protozoan	Chlamydomonadidae	ES
	volvocean protozoan	Chlamydomonadidae	ES
	volvocean protozoan	Chlamydomonadidae	ES
	volvocean protozoan	Chlamydomonadidae	ES
	volvocean protozoan	Chlamydomonadidae	ES
	volvocean protozoan	Chlamydomonadidae	ES
	volvocean protozoan	Volvocidae	ES
	volvocean protozoan	Phacotidae	ES
	volvocean protozoan	Phacotidae	ES

CLASS EUGLENEA	Common Name	Family	Location
<b>Order Euglenida (green euglenas)</b>			
<i>Ascoglena vaginicola?</i>	euglenoid protozoan	Trachelomonadidae	ES
<i>Astasia klebsii</i>	euglenoid protozoan	Euglenidae	ES
<i>Euglena acus</i>	euglenoid protozoan	Euglenidae	ES
<i>Euglena deses</i>	euglenoid protozoan	Euglenidae	ES
<i>Euglena ehrenbergii</i>	euglenoid protozoan	Euglenidae	ES
<i>Euglena gracilis</i>	euglenoid protozoan	Euglenidae	ES
<i>Euglena oxyuris</i>	euglenoid protozoan	Euglenidae	ES
<i>Euglena oxyuris</i> var. <i>minor</i>	euglenoid protozoan	Euglenidae	ES
<i>Euglena pisciformis</i>	euglenoid protozoan	Euglenidae	ES
<i>Euglena tripteris</i>	euglenoid protozoan	Euglenidae	ES
<i>Euglena vermiformis</i>	euglenoid protozoan	Euglenidae	ES
<i>Lepocinclis</i> sp.	euglenoid protozoan	Euglenidae	ES
<i>Menoidium gibbum</i>	euglenoid protozoan	Euglenidae	ES
<i>Phacus acuminatus</i>	euglenoid protozoan	Euglenidae	ES
<i>Phacus arnoldi</i>	euglenoid protozoan	Euglenidae	ES
<i>Phacus helikoides</i>	euglenoid protozoan	Euglenidae	ES
<i>Phacus pleuronectes</i>	euglenoid protozoan	Euglenidae	ES
<i>Phacus pseudoonordstedii</i>	euglenoid protozoan	Euglenidae	ES
<i>Phacus tortus</i>	euglenoid protozoan	Euglenidae	ES
<i>Rhabdomonas</i> sp.	euglenoid protozoan	Euglenidae	ES
<i>Scytomonas</i> sp.	euglenoid protozoan	Euglenidae	ES
<i>Strombomonas gibberosa</i>	euglenoid protozoan	Trachelomonadidae	ES
<i>Trachelomonas armata</i>	euglenoid protozoan	Trachelomonadidae	ES
<i>Trachelomonas hispida</i>	euglenoid protozoan	Trachelomonadidae	ES
<i>Trachelomonas horrida</i>	euglenoid protozoan	Trachelomonadidae	ES
<i>Trachelomonas spiralis</i>	euglenoid protozoan	Trachelomonadidae	ES
<i>Trachelomonas superba</i>	euglenoid protozoan	Trachelomonadidae	ES
<i>Trachelomonas varians</i>	euglenoid protozoan	Trachelomonadidae	ES
<i>Trachelomonas volvocina</i>	euglenoid protozoan	Trachelomonadidae	ES
<i>Trachelomonas volvocina</i> var. <i>minuta</i>	euglenoid protozoan	Trachelomonadidae	ES
<i>Urceolus ovatus</i>	euglenoid protozoan	Trachelomonadidae	ES
<i>Urceolus sabulosus</i>	euglenoid protozoan	Trachelomonadidae	ES
<b>Order Peranemida (colorless euglenas)</b>			
<i>Anisonema acinus</i>	colorless euglena	Anisonemidae	ES
<i>Anisonema emarginatum</i>	colorless euglena	Anisonemidae	ES
<i>Anisonema ovale</i>	colorless euglena	Anisonemidae	ES
<i>Anisonema strenuum</i>	colorless euglena	Anisonemidae	ES
<i>Anisonema truncatum</i>	colorless euglena	Anisonemidae	ES
<i>Entosiphon obliquum</i>	colorless euglena	Anisonemidae	ES
<i>Entosiphon ovatum</i>	colorless euglena	Anisonemidae	ES
<i>Entosiphon polyalux</i>	colorless euglena	Anisonemidae	ES
<i>Entosiphon sulcatum</i>	colorless euglena	Anisonemidae	ES
<i>Heteronema klebsii</i>	colorless euglena	Peranemidae	ES
<i>Notosolenus apocampius</i>	colorless euglena	Anisonemidae	ES
<i>Notosolenus obicularis</i>	colorless euglena	Anisonemidae	ES
<i>Notosolenus sinuatus</i>	colorless euglena	Anisonemidae	ES
<i>Peranema asperum</i>	colorless euglena	Peranemidae	ES
<i>Peranema inflexum</i>	colorless euglena	Peranemidae	ES
<i>Peranema trichophorum</i>	colorless euglena	Peranemidae	ES
<i>Petalomonas mediocanella</i>	colorless euglena	Petalomonadidae	ES
<i>Petalomonas minuta</i>	colorless euglena	Petalomonadidae	ES
<i>Petalomonas quadrilineata</i>	colorless euglena	Petalomonadidae	ES
<b>CLASS ZOOMASTIGOPHORA</b>			
<b>Order Choanoflagellida</b>			
<i>Codonosiga</i> sp.?	choanoflagellate	Codonosigidae	ES
<i>Codonosigopsis</i> sp.	choanoflagellate	Codonosigidae	ES
<i>Codosiga</i> sp.	choanoflagellate	Codonosigidae	ES
<i>Desmarella</i> sp.	choanoflagellate	Codonosigidae	ES

	Common Name	Family	Location
<b>Order Choanoflagellida (cont'd)</b>			
<i>Diplosiga</i> sp.	choanoflagellate	Codonosigidae	ES
<i>Monosiga ovata</i>	choanoflagellate	Codonosigidae	ES
<i>Monosiga robusta</i>	choanoflagellate	Codonosigidae	ES
<i>Poteriodendron petiolatum</i>	choanoflagellate	Salpingoecidae	ES
<i>Salpingoeca elegans</i>	choanoflagellate	Salpingoecidae	ES
<b>Order Kinetoplastida</b>			
<i>Bodo alexeieffii</i>	kinetoplastid protozoan	Bodonidae	ES
<i>Bodo amoebinus</i>	kinetoplastid protozoan	Bodonidae	ES
<i>Bodo angustus</i> [= <i>Bodo saliens</i> ]	kinetoplastid protozoan	Bodonidae	ES
<i>Bodo caudatus</i>	kinetoplastid protozoan	Bodonidae	ES
<i>Bodo celer</i>	kinetoplastid protozoan	Bodonidae	ES
<i>Bodo edax</i>	kinetoplastid protozoan	Bodonidae	ES
<i>Bodo fusiformis</i>	kinetoplastid protozoan	Bodonidae	ES
<i>Bodo globosa</i>	kinetoplastid protozoan	Bodonidae	ES
<i>Bodo minimus</i>	kinetoplastid protozoan	Bodonidae	ES
<i>Bodo obovatus</i>	kinetoplastid protozoan	Bodonidae	ES
<i>Bodo ovatus</i>	kinetoplastid protozoan	Bodonidae	ES
<i>Bodo repens</i>	kinetoplastid protozoan	Bodonidae	ES
<i>Bodo rostratus</i>	kinetoplastid protozoan	Bodonidae	ES
<i>Bodo saltans</i>	kinetoplastid protozoan	Bodonidae	ES
<i>Bodo triangularis</i>	kinetoplastid protozoan	Bodonidae	ES
<i>Bodo uncinatus</i>	kinetoplastid protozoan	Bodonidae	ES
<i>Bodo variabilis</i>	kinetoplastid protozoan	Bodonidae	ES
<i>Cercobodo</i> sp.	kinetoplastid protozoan	Bodonidae	ES
<i>Cercomonas crassicauda</i>	kinetoplastid protozoan	Bodonidae	ES
<i>Cercomonas longicauda</i>	kinetoplastid protozoan	Bodonidae	ES
<i>Colponema loxodes</i>	kinetoplastid protozoan	Bodonidae	ES
<i>Pleuromonas jaculans</i>	kinetoplastid protozoan	Bodonidae	ES
<i>Rhynchomonas nasuta</i>	kinetoplastid protozoan	Bodonidae	ES
	<b>Subphylum Sarcodina</b>		
<b>CLASS LOBOSA</b>			
<b>Order Amoebida</b>			
<i>Amoeba</i> sp.	amoeboid protozoan	Amoebidae	ES
<i>Cashia limacoides</i>	amoeboid protozoan	Hartmannellidae	ES
<i>Centropyxis</i> sp.	amoeboid protozoan	Centropyxidae	ES
<i>Hartmannella vermiformis</i>	amoeboid protozoan	Hartmannellidae	ES
<i>Hartmannella</i> sp.	amoeboid protozoan	Hartmannellidae	ES
<i>Mayorella bigemma</i>	amoeboid protozoan	Paramoebidae	ES
<i>Mayorella penardi</i>	amoeboid protozoan	Paramoebidae	ES
<i>Oscillosignum proboscidium</i>	amoeboid protozoan	Paramoebidae	ES
<i>Striamoeba quadrilineata</i>	amoeboid protozoan	Thecamoebidae	ES
<i>Striamoeba</i> sp.	amoeboid protozoan	Thecamoebidae	ES
<i>Thecamoeba striata</i>	amoeboid protozoan	Thecamoebidae	ES
<i>Trichamoeba</i> sp.	amoeboid protozoan	Amoebidae	ES
<i>Vannella miroides</i>	amoeboid protozoan	Thecamoebidae	ES
<i>Vexillifera</i> sp.	amoeboid protozoan	Paramoebidae	ES
<b>Order Schizopyrenida</b>			
<i>Naegleria gruber</i>	amoeboid protozoan	Vahlkampfiidae	ES
<i>Vahlkampfia</i> sp.	amoeboid protozoan	Vahlkampfiidae	ES
<b>Order Pelobiotida</b>			
<i>Pelomyxa</i> sp.	amoeboid protozoan	Pelomyxidae	ES
<b>Order Arcellinida</b>			
<i>Arcella discoides</i>	amoeboid protozoan	Arcellidae	ES
<i>Arcella vulgaris</i>	amoeboid protozoan	Arcellidae	ES
<i>Cochliopodium bilimbosum</i>	amoeboid protozoan	Cochliopodiidae	ES
<i>Cochliopodium minus</i>	amoeboid protozoan	Cochliopodiidae	ES
<i>Diffflugia acuminata</i>	amoeboid protozoan	Difflugiidae	ES



	Common Name	Family	Location
<b>Order Arcellinida (cont'd)</b>			
<i>Diffflugia globosa</i>	amoeboid protozoan	Difflogiidae	ES
<i>Diffflugia lobostoma</i>	amoeboid protozoan	Difflogiidae	ES
<i>Diffflugia pyriformis</i>	amoeboid protozoan	Difflogiidae	ES
<i>Hyalosphenia</i> sp.	amoeboid protozoan	Arcellidae	ES
<i>Pseudodiffflugia</i> sp.	amoeboid protozoan	Difflogiidae	ES
<b>CLASS FILOSA</b>			
<b>Order Aconchulinida</b>			
<i>Nuclearia</i> sp.	amoeboid protozoan	Vampyrellidae	ES
<i>Vampyrella lateritia</i>	amoeboid protozoan	Vampyrellidae	ES
<b>Order Testaceafilosida</b>			
<i>Cyphoderia ampulla</i>	amoeboid protozoan	Cyphoderiidae	ES
<b>CLASS GRANULORETICULOSA</b>			
<b>Order Athalamida</b>			
<i>Biomyxa vagans</i>	amoeboid protozoan	Biomyxidae	ES
<b>Order Foraminiferida</b>			
<i>Diplophrys archeri</i>	amoeboid protozoan	Lagynidae	ES
<b>CLASS HELIOZOA</b>			
<b>Order Actinophryida</b>			
<i>Actinophrys sol</i>	heliozoan	Actinophryidae	ES
<i>Actinophrys vesiculata</i>	heliozoan	Actinophryidae	ES
<i>Actinosphaerium</i> sp.	heliozoan	Actinosphaeridae	ES
<i>Ciliophrys</i> sp.	heliozoan	Ciliophryidae	ES
<b>Order Centrohelida</b>			
<i>Acanthocystis aculeata</i>	heliozoan	Acanthocystidae	ES
<i>Acanthocystis chaetophora</i>	heliozoan	Acanthocystidae	ES
<i>Acanthocystis mira</i>	heliozoan	Acanthocystidae	ES
<i>Acanthocystis myriospina</i>	heliozoan	Acanthocystidae	ES
<i>Acanthocystis turfacea</i>	heliozoan	Acanthocystidae	ES
<i>Heterophrys</i> sp.	heliozoan	Heterophryidae	ES
<i>Pompholyxophrys</i> sp.	heliozoan	Acanthocystidae	ES
<i>Raphidiocystis</i> sp.	heliozoan	Acanthocystidae	ES
<i>Raphidiophrys pallida</i>	heliozoan	Raphidiophryidae	ES
<i>Raphidiophrys</i> sp.	heliozoan	Raphidiophryidae	ES
<b>PHYLUM CILIOPHORA (PROTOZOA)</b>			
<b>CLASS KINETOFRAGMINOPHORA</b>			
<b>Order Prostomatida</b>			
<i>Balanion</i> sp.	ciliated protozoan	Holophryidae	ES
<i>Coleps bicuspis</i>	ciliated protozoan	Colepidae	ES
<i>Coleps hirtus</i>	ciliated protozoan	Colepidae	ES
<i>Coleps octospinus</i>	ciliated protozoan	Colepidae	ES
<i>Holophrya nigricans</i>	ciliated protozoan	Holophryidae	ES
<i>Holophrya</i> sp.	ciliated protozoan	Holophryidae	ES
<i>Placus ovum</i>	ciliated protozoan	Prorodontidae	ES
<i>Prorodon discolor</i>	ciliated protozoan	Prorodontidae	ES
<i>Urotricha armata</i>	ciliated protozoan	Prorodontidae	ES
<i>Urotricha farcta</i>	ciliated protozoan	Prorodontidae	ES
<i>Urotricha furcata</i>	ciliated protozoan	Prorodontidae	ES
<b>Order Haptorida</b>			
<i>Askenasia volvox</i>	ciliated protozoan	Didiniidae	ES
<i>Chaenea</i> sp.	ciliated protozoan	Enchelyidae	ES
<i>Didinium nasutum</i>	ciliated protozoan	Didiniidae	ES
<i>Enchelydium</i> sp.	ciliated protozoan	Spathidiidae	ES
<i>Lacrymaria olor</i>	ciliated protozoan	Enchelyidae	ES
<i>Mesodinium pulex</i>	ciliated protozoan	Didiniidae	ES
<i>Trachelius ovum</i>	ciliated protozoan	Tracheliidae	ES

	Common Name	Family	Location
<b>Order Haptorida (cont'd)</b>			
<i>Trachelophyllum pusillum</i>	ciliated protozoan	Enchelyidae	ES
<i>Trachelophyllum sigmoides</i>	ciliated protozoan	Enchelyidae	ES
<b>Order Pleurostomatida</b>			
<i>Acineria incurvata</i>	ciliated protozoan	Amphileptidae	ES
<i>Hemiophrys pleurosigma</i>	ciliated protozoan	Amphileptidae	ES
<i>Hemiophrys</i> sp.	ciliated protozoan	Amphileptidae	ES
<i>Litonotus anguilla</i>	ciliated protozoan	Amphileptidae	ES
<i>Litonotus cygus</i>	ciliated protozoan	Amphileptidae	ES
<i>Litonotus fasciola</i>	ciliated protozoan	Amphileptidae	ES
<i>Litonotus lamella</i>	ciliated protozoan	Amphileptidae	ES
<i>Litonotus</i> sp.	ciliated protozoan	Amphileptidae	ES
<i>Loxophyllum uninucleatum</i>	ciliated protozoan	Amphileptidae	ES
<i>Loxophyllum</i> sp.	ciliated protozoan	Amphileptidae	ES
<b>Order Colpodida</b>			
<i>Cyrtolophosis mucicola</i>	ciliated protozoan	Cyrtolophosidiidae	ES
<b>Order Nassulida</b>			
<i>Chilodontopsis ophis</i>	ciliated protozoan	Nassulidae	ES
<i>Leptopharynx sphagnetorum</i>	ciliated protozoan	Leptopharyngidae	ES
<i>Microthorax simulans</i>	ciliated protozoan	Microthoracidae	ES
<i>Trichopelma</i> sp.	ciliated protozoan	Leptopharyngidae	ES
<b>Order Cyrtophorida</b>			
<i>Chilodonella acuta</i>	ciliated protozoan	Chilodonellidae	ES
<i>Chilodonella algivora</i>	ciliated protozoan	Chilodonellidae	ES
<i>Chilodonella capucina</i>	ciliated protozoan	Chilodonellidae	ES
<i>Chilodonella labiata</i>	ciliated protozoan	Chilodonellidae	ES
<i>Chilodonella nana</i>	ciliated protozoan	Chilodonellidae	ES
<i>Chilodonella uncinata</i>	ciliated protozoan	Chilodonellidae	ES
<i>Trochilia palustris</i>	ciliated protozoan	Dysteriidae	ES
<i>Trochilia pusillum</i>	ciliated protozoan	Dysteriidae	ES
<i>Trochilia sigmoides</i>	ciliated protozoan	Dysteriidae	ES
<b>Order Suctorida</b>			
<i>Acineta tuberosa</i>	ciliated protozoan	Acinetidae	ES
<i>Sphaerophrya</i> sp.	ciliated protozoan	Podophryidae	ES
<i>Tokophrya</i> sp.	ciliated protozoan	Dendrosomatidae	ES
<b>CLASS OLIGOHYMENOPHORA</b>			
<b>Order Hymenostomatida</b>			
<i>Frontonia</i> sp.	ciliated protozoan	Frontoniidae	ES
<i>Lembadion bullinum</i>	ciliated protozoan	Lembadionidae	ES
<i>Paramecium caudatum</i>	ciliated protozoan	Parameciidae	ES
<i>Tetrhymena pyriformis</i>	ciliated protozoan	Tetrahymenidae	ES
<i>Urocentrum turbo</i>	ciliated protozoan	Urocentridae	ES
<b>Order Scuticociliatida</b>			
<i>Calyptotricha pleuronemoides</i>	ciliated protozoan	Pleuronematidae	ES
<i>Cinetochilum margaritaceum</i>	ciliated protozoan	Cinetochilidae	ES
<i>Cristigera phoenix</i>	ciliated protozoan	Cyclidiida	ES
<i>Cyclidium glaucoma</i>	ciliated protozoan	Cyclidiida	ES
<i>Cyclidium litomesum</i>	ciliated protozoan	Cyclidiida	ES
<i>Cyclidium muscicola</i>	ciliated protozoan	Cyclidiida	ES
<i>Cyclidium paucisetum</i>	ciliated protozoan	Cyclidiida	ES
<i>Cyclidium pellucidum</i>	ciliated protozoan	Cyclidiida	ES
<i>Cyclidium versatile</i>	ciliated protozoan	Cyclidiida	ES
<i>Histiobalantium natans</i>	ciliated protozoan	Histiobalantidiidae	ES
<i>Pleuronema</i> sp.	ciliated protozoan	Pleuronematidae	ES
<i>Uromema</i> sp.	ciliated protozoan	Uronematidae	ES

	Common Name	Family	Location
<b>Order Peritrichida (stalked ciliates)</b>			
<i>Vaginicola</i> sp.	stalked ciliated protozoan	Vaginicolidae	ES
<i>Vorticella campanula</i>	stalked ciliated protozoan	Vorticellidae	ES
<i>Vorticella microstoma</i>	stalked ciliated protozoan	Vorticellidae	ES
<i>Vorticella picta</i>	stalked ciliated protozoan	Vorticellidae	ES
<i>Vorticella striata</i>	stalked ciliated protozoan	Vorticellidae	ES
<i>Zoothamnium</i> sp.	stalked ciliated protozoan	Vorticellidae	ES
<b>CLASS POLYHYMENOPHORA</b>			
<b>Order Heterotrichida</b>			
<i>Spirostromum</i> sp.	ciliated protozoan	Spirostomidae	ES
<i>Stentor</i> sp.	ciliated protozoan	Stentoridae	ES
<b>Order Oligotrichida</b>			
<i>Codonella cratera</i>	ciliated protozoan	Codonellidae	ES
<i>Halteria grandunella</i>	ciliated protozoan	Halteriidae	ES
<i>Limnostrombidium</i> sp.	ciliated protozoan	Strombidiidae	ES
<i>Pelagostrombidium fallax</i>	ciliated protozoan	Strombidiidae	ES
<i>Rimostrombidium humile</i>	ciliated protozoan	Strombidiidae	ES
<i>Rimostrombidium lacustris</i>	ciliated protozoan	Strombidiidae	ES
<i>Strobilidium gyrans</i>	ciliated protozoan	Strombidiidae	ES
<i>Tintinnidium fluviatile</i>	ciliated protozoan	Tintinnidae	ES
<b>Order Hypotrichida</b>			
<i>Aspidisca costata</i>	ciliated protozoan	Aspidiscidae	ES
<i>Aspidisca lynceus</i>	ciliated protozoan	Aspidiscidae	ES
<i>Aspidisca steini</i>	ciliated protozoan	Aspidiscidae	ES
<i>Balladyna fusiformis</i>	ciliated protozoan	Holostichidae	ES
<i>Balladyna ovata</i>	ciliated protozoan	Holostichidae	ES
<i>Balladyna parvula</i>	ciliated protozoan	Holostichidae	ES
<i>Euplotes</i> sp.	ciliated protozoan	Euplotidae	ES
<i>Holostricha vernalis</i>	ciliated protozoan	Holostichidae	ES
<i>Hypotrichidium conicum</i>	ciliated protozoan	Spirofilida	ES
<i>Keronopsis</i> sp.	ciliated protozoan	Holostichidae	ES
<i>Oxytricha aeruginosa</i>	ciliated protozoan	Oxytrichidae	ES
<i>Oxytricha bifaria</i>	ciliated protozoan	Oxytrichidae	ES
<i>Oxytricha chlorelligeum</i>	ciliated protozoan	Oxytrichidae	ES
<i>Oxytricha setigera</i>	ciliated protozoan	Oxytrichidae	ES
<i>Oxytricha tricornis</i>	ciliated protozoan	Oxytrichidae	ES
<i>Stichotricha secunda</i>	ciliated protozoan	Strongylidiidae	ES
<i>Stylonychia mytilus</i>	ciliated protozoan	Oxytrichidae	ES
<i>Stylonychia notophora</i>	ciliated protozoan	Oxytrichidae	ES
<i>Tachysoma pellionella</i>	ciliated protozoan	Oxytrichidae	ES
<i>Tachysoma</i> sp.	ciliated protozoan	Oxytrichidae	ES
<i>Uroleptus</i> sp.	ciliated protozoan	Holostichidae	ES
<i>Urostyla grandis</i>	ciliated protozoan	Strongylidiidae	ES
<i>Urostyla</i> sp.	ciliated protozoan	Strongylidiidae	ES
<b>PHYLUM PORIFERA</b>			
<b>CLASS DEMOSPONGIAE (horny sponges)</b>			
<b>Order Haplosclerida</b>			
<i>Eunapius fragilis</i>	freshwater sponge	Spongillidae	LE
<b>PHYLUM CNIDARIA [=COELENTERATA]</b>			
<b>CLASS HYDROZOA (hydras)</b>			
<b>Order Hydroida</b>			
<i>Hydra americana</i>	hydra	Hydridae	ES
<b>Order Trachylina</b>			
<i>Craspedacusta sowerbyi</i>	freshwater jellyfish	Petasidae	CK,TR

	Common Name	Family	Location
<b>PHYLUM PLATYHELMINTHES</b>			
<b>CLASS TURBELLARIA (flatworms)</b>			
<b>Order Catenulida (catenulids)</b>			
<i>Stenostomum</i> sp.	turbellarian flatworm	Stenostomidae	ES
<b>Order Neorhabdocoela</b>			
<i>Microdalyellia</i> sp.?	turbellarian flatworm	Dalyellioda	ES
<i>Mesostoma</i> sp.?	turbellarian flatworm	Typhloplanidae	ES
<b>Order Tricladida (planarians)</b>			
<i>Dugesia tigrina</i>	planaria	Planariidae	CK
<i>Hymanella retenuova</i>	planaria	Planariidae	ES
<b>PHYLUM GASTROTRICHA</b>			
<b>Order Chaetonotida (gastrotrichs)</b>			
<i>Chaetonotus</i> sp.	gastrotrich	Chaetonotidae	ES
<b>PHYLUM ROTIFERA</b>			
<b>CLASS BDELLOIDEA (rotifers)</b>			
<b>Order Bdelloida</b>			
<i>Philodina</i> sp.	rotifer	Philodinidae	ES
<i>Rotaria neptunia</i>	rotifer	Philodinidae	ES
<b>CLASS MONOGONONTA (rotifers)</b>			
<b>Order Ploima</b>			
<i>Ascomorpha ecaudis</i>	rotifer	Gastropodidae	ES
<i>Asplanchna priodonta</i>	rotifer	Asplanchnidae	ES
<i>Brachionus angularis</i>	rotifer	Brachionidae	ES
<i>Brachionus bidentata</i>	rotifer	Brachionidae	ES
<i>Brachionus calyciflorus</i>	rotifer	Brachionidae	ES
<i>Brachionus caudatus</i>	rotifer	Brachionidae	ES
<i>Brachionus havanaensis</i>	rotifer	Brachionidae	ES
<i>Brachionus quadridentatus</i>	rotifer	Brachionidae	ES
<i>Brachionus urceolaris</i>	rotifer	Brachionidae	ES
<i>Euchlanis parva</i>	rotifer	Brachionidae	ES
<i>Kellicottia longispina</i>	rotifer	Brachionidae	ES
<i>Keratella cochlearis</i>	rotifer	Brachionidae	ES
<i>Keratella cochlearis</i> forma <i>tecta</i>	rotifer	Brachionidae	ES
<i>Keratella cochlearis</i> forma <i>typica</i>	rotifer	Brachionidae	ES
<i>Keratella quadrata</i>	rotifer	Brachionidae	ES
<i>Lecane luna</i>	rotifer	Lecanidae	ES
<i>Platyias patulus</i>	rotifer	Brachionidae	ES
<i>Ploesoma hudsoni</i>	rotifer	Synchaetidae	ES
<i>Polyarthra dolichoptera</i>	rotifer	Synchaetidae	ES
<i>Polyarthra remata</i>	rotifer	Synchaetidae	ES
<i>Sychaeta kitina</i>	rotifer	Synchaetidae	ES
<i>Sychaeta stylata</i>	rotifer	Synchaetidae	ES
<i>Trichocerca multicroinis</i>	rotifer	Trichocercidae	ES
<i>Trichotria tetractis</i>	rotifer	Brachionidae	ES
<b>Order Floscularicea (rotifers)</b>			
<i>Conochilus</i> sp.	rotifer	Conochilidae	LE
<i>Filinia</i> sp.	rotifer	Testudinellidae	ES
<i>Floscularia</i> sp.	rotifer	Flosculariidae	ES
<i>Sinantherina</i> sp.	rotifer	Flosculariidae	ES
<b>PHYLUM NEMATODA</b>			
<b>CLASS ADENOPHOREA (roundworms)</b>			
<b>Order Enoplida</b>			
<i>Tobrilus</i> sp.	roundworm	Tripylidae	ES

	Common Name	Family	Location
<b>Order Dorylaimida</b> <i>Dorylaimus</i> sp.	roundworm	Dorylaimidae	ES
<b>Order Tylenchida</b> <i>Criconemoides</i> sp.	roundworm	Criconematidae	ES
<b>PHYLUM MOLLUSCA</b>			
<b>CLASS GASTROPODA (snails)</b> <b>Order Mesogastropoda</b> <i>Cipangopaludina japonicus</i>	Japanese mystery snail	Viviparidae	ES
<b>Order Basommatophora (freshwater snails)</b> <i>Ferrissia parallela</i> <i>Fossaria</i> sp. [=Galba sp.] <i>Gyraulus deflectus</i> <i>Helisoma anceps anceps</i> <i>Lymnaea megasoma</i> [=Bulimnaea m.] <i>Physa</i> sp. <i>Physella gyrina</i> <i>Pseudosuccinea columella</i>	oblong ancyloid fossaria flexed gyro two-ridge rams-horn mammoth lymnaea physa tadpole physa mimic lymnaea	Ancyliidae Lymnaeidae Planorbidae Planorbidae Lymnaeidae Physidae Physidae Lymnaeidae	ES ES ES ES ES ES ES ES
<b>Order Stylommatophora (land snails)</b> <i>Mesodon thyroideus</i>	white-lip globe	Polygyridae	ES
<b>CLASS BIVALVIA (clams)</b>			
<b>Order Unionoida</b> <i>Amblema plicata plicata</i> <i>Anodontoides ferussacianus</i> <i>Cyclonaias tuberculata</i> <i>Elliptio dilatata</i> <i>Lampsilis radiata luteola</i> <i>Lampsilis ventricosa</i> <i>Lasmigona compressa</i> <i>Leptodea fragilis</i> <i>Ligumia recta</i> <i>Potamilus alatus</i> <i>Pyganodongrandis grandis</i> <i>Ptychobranhus fasciolaris</i> <i>Quadrula pustulosa pistulosa</i> <i>Toxolasma parvus</i> <i>Truncilla donaciformis</i> <i>Truncilla truncilla</i> <i>Utterbackia imbecillis</i>	threeridge cylindrical papershell purple wartyback spike lampmussel fatmucket creek heelsplitter fragile papershell black sandshell pink heelsplitter giant floater kidneyshell pimpleback lilliput fawnsfoot deertoe paper pondshell	Unionoidae Unionoidae Unionoidae Unionoidae Unionoidae Unionoidae Unionoidae Unionoidae Unionoidae Unionoidae Unionoidae Unionoidae Unionoidae Unionoidae Unionoidae Unionoidae Unionoidae Unionoidae Unionoidae Unionoidae	LE TR LE LE,TR LE,TR LE,TR LE TR LE LE ES,LE ES,LE LE LE LE LE LE ES,LE
<b>Order Veneroida</b> <i>Dreissena bugensis</i> <i>Dreissena polymorpha</i> <i>Musculium securis</i> [=Sphaerium securis] <i>Musculium</i> sp. <i>Pisidium compressum</i>	quagga mussel zebra mussel pond fingernail clam fingernail clam ridge-beak peaclam	Dreissenidae Dreissenidae Pisidiidae Pisidiidae Pisidiidae	LE ES,LE ES ES ES
<b>PHYLUM ANNELIDA</b>			
<b>CLASS HIRUDINEA (leeches)</b> <b>Order Rhynochobdella</b> <i>Batrachobdella phalera</i> <i>Glossiphonia</i> sp. <i>Helobdella stagnalis</i> <i>Placobdella</i> sp.	leech leech leech leech	Glossiphoniidae Glossiphoniidae Glossiphoniidae Glossiphoniidae	ES ES ES ES
<b>CLASS OLIGOCHAETA (segmented worms)</b> <b>Order Lumbriculida</b> <i>Lumbriculus variegatus</i> <i>Stylodrilus heringianus</i>	aquatic earthworm aquatic earthworm	Lumbriculidae Lumbriculidae	ES ES

Order Haplotaxida	Common Name	Family	Location
<i>Aeolosoma headleyi</i>	aquatic earthworm	Aeolosomatidae	ES
<i>Aeolosoma hemprichi</i>	aquatic earthworm	Aeolosomatidae	ES
<i>Amphichaeta leydigii</i>	naidid worm	Naididae	ES
<i>Aulodrilus limnobius</i>	tubificid worm	Tubificidae	ES
<i>Aulodrilus pigueti</i>	tubificid worm	Tubificidae	ES
<i>Aulodrilus pluriseta</i>	tubificid worm	Tubificidae	ES
<i>Branchirua sowerbyi</i>	tubificid worm	Tubificidae	ES
<i>Chaetogaster diaphanus</i>	naidid worm	Naididae	ES
<i>Chaetogaster diastrophus?</i>	naidid worm	Naididae	ES
<i>Chaetogaster limnaei</i>	naidid worm	Naididae	ES
<i>Dero nivea</i>	naidid worm	Naididae	ES
<i>Dero trifida?</i>	naidid worm	Naididae	ES
<i>Dero vaga</i> [=Auloporus vaga]	naidid worm	Naididae	ES
<i>Haemonais waldvogeli</i>	naidid worm	Naididae	ES
<i>Ilyodrilus templetoni</i>	tubificid worm	Tubificidae	ES
<i>Limnodrilus hoffmeisteri</i>	tubificid worm	Tubificidae	ES
<i>Limnodrilus maumeensis</i>	tubificid worm	Tubificidae	ES
<i>Limnodrilus profundicola</i>	tubificid worm	Tubificidae	ES
<i>Limnodrilus udekemianus</i>	tubificid worm	Tubificidae	ES
<i>Limnodrilus cervix</i>	tubificid worm	Tubificidae	ES
<i>Limnodrilus claparedeianus</i>	tubificid worm	Tubificidae	ES
<i>Nais barbata</i>	naidid worm	Naididae	ES
<i>Nais communis</i>	naidid worm	Naididae	ES
<i>Nais elinguis</i>	naidid worm	Naididae	ES
<i>Nais pardalis</i>	naidid worm	Naididae	ES
<i>Nais pseudobtusa</i>	naidid worm	Naididae	ES
<i>Nais variabilis</i>	naidid worm	Naididae	ES
<i>Ophidonais serpentina</i>	naidid worm	Naididae	ES
<i>Pristina longiseta longiseta</i>	naidid worm	Naididae	ES
<i>Pristina sima?</i>	naidid worm	Naididae	ES
<i>Pristinaella osborni</i>	naidid worm	Naididae	ES
<i>Pristinella acuminata?</i>	naidid worm	Naididae	ES
<i>Pristinella jenkiniae</i>	naidid worm	Naididae	ES
<i>Quistadrilus multisetosus</i>	tubificid worm	Tubificidae	ES
<i>Rhyacodrilus coccineus</i>	tubificid worm	Tubificidae	ES
<i>Telmatodrilus</i> sp.?	tubificid worm	Tubificidae	ES
<i>Vejdovskyella comata</i>	naidid worm	Naididae	ES
<i>Vejdovskyella intermedia</i>	naidid worm	Naididae	ES
<b>PHYLUM ARTHROPODA</b>			
<b>CLASS ARACHNIDA</b>			
<b>Order Araneae (spiders)</b>			
<i>Achaearanea tepidariorum</i>	American house spider	Theridiidae	CK
<i>Agelenopsis pennsylvanica</i>	green spider	Agelenidae	CK
<i>Agroeca pratensis?</i>	sac spider	Clubionidae	ES
<i>Allocosa funerea</i>	wolf spider	Lycosidae	CK
<i>Alopecosa aculeata?</i>	wolf spider	Lycosidae	CK
<i>Anyphaena celer</i>	hunting spider	Anyphaenidae	CK
<i>Araneus marmoreus</i>	marbled orb weaver	Araneidae	CK
<i>Araneus trifolium</i>	orb weaver	Araneidae	CK
<i>Argiope aurantia</i>	black & yellow garden spider	Araneidae	CK
<i>Argiope trifasciata</i>	banded garden	Araneidae	CK
<i>Atopogyna cornupalis</i>	sheet-web weaver	Linyphiidae	CK
<i>Bathyphantes</i> sp.?	sheet-web weaver	Linyphiidae	CK
<i>Callobius</i> sp.?	thread-web weaver	Amaurobiidae	CK
<i>Castianeira cingulata</i>	sac spider	Clubionidae	CK
<i>Ceraticelus fissiceps</i>	dwarf spider	Linyphiidae	CK
<i>Cheiracanthium mildei</i>	sac spider	Clubionidae	CK
<i>Cicurina pallida</i>	loose-web weaver	Dictynidae	CK
<i>Cirurina robusta</i>	funnel web weaver	Agelenidae	CK

Order Araneae (cont'd)	Common Name	Family	Location
<i>Clubiona</i> sp.	sac spider	Clubionidae	CK
<i>Clubionoides excepta</i> ?	sac spider	Clubionidae	CK
<i>Coras medicinalis</i>	funnel web weaver	Agelenidae	CK
<i>Coriarachne versicolor</i> ?	crab spider	Thomisidae	CK
<i>Crustulina altera</i>	comb-footed spider	Theridiidae	CK
<i>Cyclosa conica</i>	orb weaver	Araneidae	CK
<i>Dictynia annulipes</i>	loose-web weaver	Dictynidae	CK
<i>Dolomedes tenebrosus</i> ?	nursery web spider	Pisauridae	CK
<i>Eris militaris</i>	jumping spider	Salticidae	CK
<i>Ero canionis</i>	ambush spider	Mimetidae	ES
<i>Eustala anastera</i>	orb weaver	Araneidae	CK
<i>Frontinella pyramitela</i>	sheet-web weaver	Linyphiidae	CK
<i>Gea heptagon</i>	orb weaver	Araneidae	CK
<i>Habrocestum pulex</i>	jumping spider	Salticidae	CK
<i>Herpyllus ecclesiasticus</i>	parson spider	Gnaphosidae	CK
<i>Hogna helluo</i>	wolf spider	Lycosidae	ES
<i>Hogna rabida</i>	wolf spider	Lycosidae	ES
<i>Lepthyphantes zebra</i>	sheet-web weaver	Linyphiidae	CK
<i>Maevia inclemens</i> ?	jumping spider	Salticidae	CK
<i>Mangora placida</i>	orb weaver	Araneidae	CK
<i>Meioneta unimaculata</i>	sheet-web weaver	Linyphiidae	CK
<i>Metaphidippus</i> sp.	jumping spider	Salticidae	CK
<i>Micrathena gracilis</i>	orb weaver	Araneidae	CK
<i>Misumenoides formosipes</i>	crab spider	Thomisidae	CK
<i>Misumenops asperatus</i> ?	crab spider	Thomisidae	CK
<i>Neoscona crucifera</i>	orb weaver	Araneidae	CK
<i>Neriene radiata</i> ? [or <i>Microlin</i> sp.]	sheet-web weaver	Linyphiidae	CK
<i>Pardosa milvina</i>	wolf spider	Lycosidae	CK
<i>Pardosa moesta</i> ?	thin-legged wolf spider	Lycosidae	CK
<i>Pardosa saxatilis</i>	wolf spider	Lycosidae	ES
<i>Phidippus audax</i>	jumping spider	Salticidae	CK
<i>Phidippus clarus</i>	jumping spider	Salticidae	CK
<i>Phidippus whitmani</i>	jumping spider	Salticidae	CK
<i>Philodromus keyserlingi</i>	crab spider	Thomisidae	CK
<i>Philodromus vulgaris</i>	crab spider	Thomisidae	CK
<i>Pholcus phalangioides</i>	cellar spider	Pholcidae	CK
<i>Pirata minutus</i> ?	wolf spider	Lycosidae	CK
<i>Pisaurina mira</i>	nursery web spider	Pisauridae	CK
<i>Pityohyphantes costatus</i>	hammock spider	Linyphiidae	CK
<i>Platycryptus undatus</i>	jumping spider	Salticidae	CK
<i>Salticus scenicus</i>	jumping spider	Salticidae	CK
<i>Schizocosa avida</i>	wolf spider	Lycosidae	CK
<i>Schizocosa ocreata</i>	wolf spider	Lycosidae	CK
<i>Sitticus</i> sp.	jumping spider	Salticidae	CK
<i>Steatoda borealis</i>	comb-footed spider	Theridiidae	CK
<i>Steatoda triangulosa</i>	comb-footed spider	Theridiidae	CK
<i>Tetragnatha elongata</i>	stilt-legged spider	Tetragnathidae	CK
<i>Tetragnatha laboriosa</i>	long-jawed orb weaver	Tetragnathidae	CK
<i>Theridion frondeum</i>	comb-footed spider	Theridiidae	CK
<i>Tmarus angulatus</i>	crab spider	Thomisidae	CK
<i>Trachelas tranquillus</i>	sac spider	Clubionidae	CK
<i>Tutelina elegans</i>	jumping spider	Salticidae	CK
<i>Verrucosa arenata</i>	orb weaver	Araneidae	CK
<i>Xysticus elegans</i>	crab spider	Thomisidae	CK
<i>Xysticus ferox</i>	crab spider	Thomisidae	CK
<i>Xysticus funestus</i>	crab spider	Thomisidae	CK
<b>Order Acariformes (mites)</b>			
<i>Limnesia</i> sp.	freshwater mite	Limnessiidae	ES
<i>Neumania</i> sp.	clam mite	Unionicolidae	ES
<i>Unionicola</i> sp.	clam mite	Unionicolidae	ES

CLASS CRUSTACEA (crustaceans)	Common Name	Family	Location
<b>Subclass Branchiopoda</b>			
<b>Order Cladocera (water fleas)</b>			
<i>Alona barbulata?</i>	water flea	Chydoridae	CK,ES
<i>Alona cf. circumfimbriata</i>	water flea	Chydoridae	CK
<i>Alona costata</i>	water flea	Chydoridae	ES
<i>Alona guttata</i>	water flea	Chydoridae	ES
<i>Alona quadrangularis</i>	water flea	Chydoridae	CK,ES,LE
<i>Alonella excisa</i> [or <i>Alonella exigua?</i> ]	water flea	Chydoridae	ES
<i>Alonella hamulata</i>	water flea	Chydoridae	CK,ES
<i>Alonella nana</i>	water flea	Chydoridae	ES
<i>Alonella setulosa</i>	water flea	Chydoridae	ES,LE
<i>Bosmina longirostris</i>	water flea	Bosminidae	ES
<i>Bythotrephes cederstroemi</i>	spiny water flea	Cercopagidae	LE
<i>Ceriodaphnia lacustris</i>	water flea	Daphnidae	CK,ES
<i>Ceriodaphnia quadrangula</i>	water flea	Daphnidae	ES
<i>Ceriodaphnia reticulata</i>	water flea	Daphnidae	ES
<i>Chydorus sphaericus</i>	water flea	Chydoridae	ES
<i>Daphnia catawba</i>	water flea	Daphnidae	LE
<i>Daphnia galeata mendotae</i>	water flea	Daphnidae	CK,ES,LE
<i>Daphnia parvula</i>	water flea	Daphnidae	CK,LE
<i>Daphnia retrocurva</i>	water flea	Daphnidae	CK,ES,LE
<i>Diaphanosoma birgei</i>	water flea	Sididae	CK,ES,LE
<i>Disparalona leei</i>	water flea	Chydoridae	CK,ES,LE
<i>Eubosmina coregoni</i> [= <i>Bosmina coregoni</i> ]	water flea	Bosminidae	CK,ES,LE
<i>Ilyocryptus sordidus</i>	water flea	Macrothricidae	CK,ES,LE
<i>Latona setifera</i>	water flea	Sididae	ES
<i>Leptodora kindtii</i>	large water flea	Leptodoridae	LE
<i>Leydigia acanthocercoides</i>	water flea	Chydoridae	ES
<i>Leydigia leydigi</i>	water flea	Chydoridae	CK,ES,LE
<i>Macrothrix laticornis</i>	water flea	Macrothricidae	CK,ES
<i>Moina micrura</i>	water flea	Moinidae	CK,ES
<i>Pleuroxus cf. denticulatus</i>	water flea	Chydoridae	CK,ES
<i>Pleuroxus procurvus</i>	water flea	Chydoridae	CK,ES
<i>Pseudochydorus globosus</i>	water flea	Chydoridae	CK,ES
<i>Scapholeberis kingi</i>	water flea	Daphnidae	ES
<i>Scapholeberis mucronata</i>	water flea	Daphnidae	ES
<i>Sida crystallina</i>	water flea	Sididae	ES
<i>Simocephalus serrulatus</i>	water flea	Daphnidae	CK,ES
<b>Subclass Ostracoda (seed shrimps)</b>			
<b>Order Podocopina</b>			
<i>Candona simpsoni</i>	seed shrimp	Candonidae	ES
<i>Cypria maculata</i>	seed shrimp	Cypridae	ES
<i>Cypria ophthalmica</i>	seed shrimp	Cypridae	ES
<i>Cypria pellucida</i>	seed shrimp	Cypridae	ES
<i>Cypridopsis vidua</i>	seed shrimp	Cypridopsidae	ES
<i>Darwinula stevensoni</i>	seed shrimp	Darwinulidae	ES
<i>Pelocypris</i> sp.	seed shrimp	Ilyocypridae	ES
<i>Physocypris pustulosa</i>	seed shrimp	Cypridae	ES
<b>Subclass Copepoda (copepods)</b>			
<b>Order Calanoida</b>			
<i>Diaptomus</i> sp.	copepod	Diaptomidae	ES
<i>Epischura lacustris</i>	copepod	Temoridae	ES
<i>Eurytemora affinis</i>	copepod	Temoridae	CK,ES,LE
<i>Leptodiaptomus ashlandi</i>	copepod	Diaptomidae	CK,ES,LE
<i>Leptodiaptomus minutus</i>	copepod	Diaptomidae	ES,LE
<i>Leptodiaptomus sicilis</i>	copepod	Diaptomidae	ES,LE
<i>Leptodiaptomus siciloides</i>	copepod	Diaptomidae	CK,ES,LE
<i>Skistodiaptomus oregonensis</i>	copepod	Diaptomidae	CK,ES,LE
<i>Skistodiaptomus pallidus</i>	copepod	Diaptomidae	CK,ES



	Common Name	Family	Location
<b>Order Cyclopoida</b>			
<i>Acanthocyclops vernalis sensu lata</i>	copepod	Cyclopidea	CK,ES,LE
<i>Cyclops varicans rubellus?</i>	copepod	Cyclopidea	CK,ES,LE
<i>Diacyclops cf. navus</i>	copepod	Cyclopidea	ES
<i>Diacyclops nearcticus</i>	copepod	Cyclopidea	ES
<i>Diacyclops thomasi</i>	copepod	Cyclopidea	CK,ES,LE
<i>Eucyclops agilis</i>	copepod	Cyclopidea	ES,LE
<i>Eucyclops elegans [=E. speratus]</i>	copepod	Cyclopidea	ES
<i>Macrocyclus albidus</i>	copepod	Cyclopidea	ES
<i>Mesocyclops edax</i>	copepod	Cyclopidea	CK,ES,LE
<i>Microcyclops varicans rubellus</i>	copepod	Cyclopidea	ES
<i>Paracyclops fimbriatus poppei</i>	copepod	Cyclopidea	ES
<i>Tropocyclops prasinus mexicanus</i>	copepod	Cyclopidea	CK,ES,LE
<b>Order Harpacticoida</b>			
<i>Attheyella illinoisensis</i>	copepod	Canthocamptidae	ES
<i>Bryocamptus sp.</i>	copepod	Canthocamptidae	ES
<i>Canthocamptus robertcockeri</i>	copepod	Canthocamptidae	ES
<i>Nitocra hibernica</i>	copepod	Canthocamptidae	ES
<b>Subclass Branchiura</b>			
<b>Order Arguloidea (fish lice)</b>			
<i>Argulus sp.</i>	fish louse	Argulidae	ES
<b>Subclass Malacostraca</b>			
<b>Order Isopoda (sowbugs)</b>			
<i>Asellus sp. [=Caecidotea sp.]</i>	aquatic sowbug	Asellidae	ES
<i>Caecidotea racovitzai racovitzai</i>	aquatic sowbug	Asellidae	ES
<b>Order Amphipoda (scuds)</b>			
<i>Crangonyx gracilis</i>	sideswimmer	Gammaridae	ES
<i>Gammarus fasciatus</i>	sideswimmer	Gammaridae	ES
<i>Gammarus pseudolimnaeus</i>	sideswimmer	Gammaridae	ES
<i>Hyalella azteca</i>	sideswimmer	Talitridae	ES
<b>Order Decapoda (crayfishes &amp; shrimps)</b>			
<i>Cambarus diogones</i>	devil crawfish	Cambaridae	ES
<i>Orconectes rusticus</i>	rusty crayfish	Cambaridae	ES
<i>Palaemonetes kadiakensis</i>	Mississippi glass shrimp	Palaemonidae	ES
<b>CLASS INSECTA (insects)</b>			
<b>Order Collembola (springtails)</b>			
entomobryid sp.	springtail	Entomobryidae	CK,ES
isotomid sp.	springtail	Isotomidae	ES
<b>Order Diplura (diplurans)</b>			
dipluran sp.	dipluran	Campodeidae	CK
<b>Order Thysanura (bristletails)</b>			
lepismatid sp.	silverfish	Lepismatidae	CK
<b>Order Ephemeroptera (mayflies)</b>			
<i>Baetis sp.</i>	bluewing olive	Baetidae	ES,TR
<i>Caenis simulans</i>	squaregill mayfly	Caenidae	CK
<i>Ephemerella sp.</i>	burrowing mayfly	Ephemeridae	TR
<i>Ephemerella sp.</i>	spiny crawler	Ephemerellidae	CK
<i>Ephoron sp.</i>	pale burrowing mayfly	Polymitarcyidae	TR
<i>Heptagenia pulla</i>	flatheaded mayfly	Heptageniidae	CK
<i>Heptagenia sp.</i>	flatheaded mayfly	Heptageniidae	CK
<i>Hexagenia limbata</i>	burrowing mayfly	Ephemeridae	ES
<i>Isonychia sicca</i>	brushlegged mayfly	Oligoneuriidae	CK
<i>Leptophlebia sp.</i>	pronggill mayfly	Leptophlebiidae	ES
<i>Stenacron sp.</i>	flatheaded mayfly or yellow may	Heptageniidae	CK,TR
<i>Stenonema femoratum</i>	flatheaded mayfly or pale red fox	Heptageniidae	CK

Order Odonata (damselflies & dragonflies)	Common Name	Family	Location
<i>Aeshna</i> sp.	blue darner or paddletail	Aeshnidae	ES
<i>Anax junius</i>	big green darner	Aeshnidae	ES,CK
<i>Argia fumipennis</i>	dancer	Coenagrionidae	TR
<i>Argia tibialis</i>	dancer	Coenagrionidae	CK,ES
<i>Argia translata</i>	dancer	Coenagrionidae	TR
<i>Argia apicalis</i>	dancer	Coenagrionidae	ES
<i>Argia meosta</i>	dancer	Coenagrionidae	ES
<i>Argia violacea</i>	purple damselfly or violet dancer	Coenagrionidae	ES
<i>Calopteryx maculata</i> [= <i>Agrion maculatus</i> ]	blackwinged damselfly	Calopterygidae	CK,TR
<i>Calopteryx</i> sp.	bandwing damselfly	Calopterygidae	ES
<i>Celithemis elisa</i>	spotted skimmer/ calico pennant	Libellulidae	CK,TR
<i>Chromagrion</i> sp.	variegated damsel	Coenagrionidae	TR
<i>Dromogokmphus spinosus</i>	spinylegged clubtail	Gomphidae	TR
<i>Dromogokmphus spoliatus</i>	spinylegged clubtail	Gomphidae	TR
<i>Enallagma antennatum</i>	bluet	Coenagrionidae	CK,ES
<i>Enallagma civile</i>	civil bluet	Coenagrionidae	CK,ES
<i>Enallagma exsulans</i>	bluet	Coenagrionidae	CK
<i>Enallagma signatum</i>	bluet	Coenagrionidae	CK
<i>Enallagma vespersum</i>	bluet	Coenagrionidae	ES
<i>Epitheca princeps</i>	royal skimmer	Corduliidae	ES
<i>Erythemis simplicicollis</i>	eastern pondhawk	Libellulidae	CK,ES,TR
<i>Hagenius brevistylus</i>	black dragonfly	Gomphidae	TR
<i>Hetaerina americana</i>	American ruby spot	Calopterygidae	ES
<i>Ischnura posita</i>	forktail	Coenagrionidae	CK,ES
<i>Ischnura verticalis</i>	forktail	Coenagrionidae	CK,ES
<i>Lestes forcipatus</i>	marsh spreadwing	Lestidae	TR
<i>Leucorrhinia</i> sp.	whitefaced skimmer	Libellulidae	ES
<i>Libellula luctuosa</i>	widow dragonfly	Libellulidae	CK,TR
<i>Libellula pulchella</i>	tenspot dragonfly	Libellulidae	CK,ES
<i>Macromia illinoiensis</i>	river skimmer	Macromiidae	TR
<i>Macromia taeniolata</i>	river skimmer	Macromiidae	TR
<i>Nehalennia irene</i>	green damsel	Coenagrionidae	ES
<i>Pachydiplax longipennis</i>	blue pirate	Libellulidae	ES
<i>Pantala flavescens</i>	yellow skimmer	Libellulidae	TR
<i>Pantala hymenea</i>	globe skimmer	Libellulidae	CK,ES,TR
<i>Perithemis tenera</i>	eastern amber-winged skimmer	Libellulidae	CK,ES,TR
<i>Plathemis lydia</i>	common white-tailed skimmer	Libellulidae	CK,TR
<i>Sympetrum rubicundulum</i>	red skimmer	Libellulidae	TR
<i>Sympetrum semicinctum</i>	red skimmer	Libellulidae	TR
<i>Tamea lacerata</i>	raggedy skimmer	Libellulidae	TR
<i>Tamea onusta</i>	red saddlebags dragonfly	Libellulidae	CK
<b>Order Blattaria (cockroaches)</b>			
<i>Blatta orientalis</i> ?	Oriental cockroach	Blattellidae	CK
<i>Parcoblatta</i> sp.?	wood cockroach	Blattellidae	CK
<i>Periplaneta americana</i> ?	American cockroach	Blattellidae	CK
<b>Order Mantodea (mantids)</b>			
<i>Tenodera aridifolia sinensis</i>	Chinese mantid/praying mantis	Mantidae	CK,TR
<b>Order Isoptera (termites)</b>			
<i>Reticulitermes flavipes</i>	eastern subterranean termite	Rhinotermitidae	CK
<b>Order Orthoptera (crickets &amp; grasshoppers)</b>			
acridid sp.	eastern lubber grasshopper	Acrididae	CK
<i>Ceuthophilus</i> sp.	camel or cave cricket	Gryllacrididae	CK
cyrtacanthacridin sp.	spur-throated grasshopper	Acrididae	CK
<i>Ellipes minuta minuta</i>	pygmy mole cricket	Tridactylidae	ES,TR
<i>Gryllus</i> sp.	field cricket	Gryllidae	CK
<i>Microcentrum rhombifolium</i>	broad-winged katydid	Tettigoniidae	CK
<i>Neocurtilla hexadactyla</i>	northern mole cricket	Gryllotalpidae	CK
<i>Nomotetrix cristatus</i>	pygmy grasshopper	Tetrigidae	TR

	Common Name	Family	Location
<b>Order Orthoptera (cont'd)</b>			
<i>oedipidin</i> sp.	band-winged grasshopper	Acrididae	CK
<i>Paratettix cueullatus</i>	pygmy grasshopper	Tetrigidae	TR
<i>Pterophylla camellifolia</i>	northern katydid	Tettigoniidae	CK
tetrigid sp.	pygmy grasshopper	Tetrigidae	CK
tridactylid sp.	pygmy mole cricket	Tridactylidae	ES
<b>Order Dermaptera (earwigs)</b>			
<i>Euborellia annulipes?</i>	ring-legged earwig	Labiduridae	TR
<i>Forficula auricularia?</i>	European earwig	Forficulidae	CK
<i>Labia</i> sp.?	little earwig	Labiidae	CK
<b>Order Plecoptera (stoneflies)</b>			
<i>Acroneuria</i> sp.	stonefly	Perlidae	TR
<i>Allocaupina recta</i>	spring stonefly	Capniidae	CK
<i>Allocaupina vivapara</i>	spring stonefly	Capniidae	CK
chloroperlid sp.	green stonefly	Chloroperlidae	CK
<i>Isoperla duplicata</i>	green-winged stonefly	Perlodidae	CK
nemourid sp.	broadback stonefly	Nemouridae	CK
<i>Neoperla</i> sp.	stonefly	Perlidae	TR
<i>Neophasganophora</i> sp.	great stonefly	Perlidae	TR
<i>Paragnetina</i> sp.	stonefly	Perlidae	CK,TR
<i>Perlesta</i> sp.	stonefly	Perlidae	TR
<i>Perlinella</i> sp.	stonefly	Perlidae	TR
taeniopterygid sp.	broadback stonefly	Taeniopterygida	CK
<b>Order Thysanoptera (thrips)</b>			
aeolothripid sp.	banded thrips	Aeolothripidae	CK
phlaeothripid sp.	mullin thrips	Phlaeothripidae	CK
thripid sp.	thrips	Thripidae	ES
<b>Order Hemiptera (true bugs)</b>			
alydid sp.	broad-headed bug	Alydidae	CK
<i>Anasa tristis</i>	squash bug	Coreidae	CK
<i>Aquarius</i> sp.	water strider	Gerridae	TR
<i>Aradus</i> sp.	flat bug	Aradidae	CK
<i>Arhysus lateralis</i>	scentless plant bug	Rhopalidae	CK
<i>Belostoma flumineum</i>	giant water bug	Belostomatidae	ES
<i>Corisella inscripta</i>	water boatman	Corixidae	ES
<i>Corythuca pruni</i>	lace bug	Tingidae	CK
cydnid sp.	burrower bug	Cydnidae	CK
<i>Euschistus icterius</i>	stink bug	Pentatomidae	CK
<i>Gelastocoris</i> sp.	toad bug	Gelastocoridae	TR
<i>Geocoris uliginosis</i>	big-eyed bug	Lygaeidae	CK
<i>Gerris buenoi</i>	water strider	Gerridae	ES
<i>Gerris canaliculatus</i>	water strider	Gerridae	ES
<i>Gerris comatus</i>	water strider	Gerridae	ES
<i>Gerris marginatus</i>	water strider	Gerridae	ES
<i>Gerris remigis</i>	water strider	Gerridae	ES
<i>Hesperocorixa lucida</i>	water boatman	Corixidae	ES
<i>Hesperocorixa</i> sp.	water boatman	Corixidae	TR
<i>Hoplistoscelus sordidus</i>	damsel bug	Nabidae	CK
<i>Hydrometra martini</i>	water measurer	Hydrometridae	ES
<i>Hydrometra</i> sp.	water measurer	Hydrometridae	CK
<i>Lasiomerus</i> sp.	damsel bug	Nabidae	CK
<i>Leptocoris trivittatus</i>	boxelder bug	Rhopalidae	CK
<i>Leptoglossus oppositus?</i>	lead-footed bug	Coreidae	CK
<i>Leptoptera dolabrata</i>	meadow plant bug	Miridae	CK
<i>Lygaeus kalmii</i>	small milkweed bug	Lygaeidae	CK
<i>Lygus lineolaris?</i>	tarnished plant bug	Miridae	CK
<i>Merragata</i> sp.	velvet water bug	Hebridae	TR
<i>Mesovelia mulsanti</i>	water treader	Mesoveliidae	ES
<i>Mesovelia</i> sp.	water treader	Mesoveliidae	ES

Order Hemiptera cont'd)	Common Name	Family	Location
<i>Metrobates hesperius</i>	water strider	Gerridae	TR
<i>Micracanthia</i> sp.	shore bug	Saldidae	CK,ES
<i>Microwelia</i> sp.?	small water strider	Veliidae	CK,TR
<i>Myodocha serrripes</i>	seed bug	Lygaeidae	CK
<i>Nabis</i> sp.	damsel bug	Nabidae	CK
<i>Nepa</i> sp.	oval water scorpion	Nepidae	TR
<i>Notonecta irrorata</i>	backswimmer	Notonectidae	ES
<i>Notonecta raleighi lunata</i>	backswimmer	Notonectidae	ES
<i>Notonecta undulata</i>	backswimmer	Notonectidae	ES
<i>Orius insidiosus</i>	insidious flower bug	Anthocoridae	CK
<i>Palmacorixa buenoi</i>	water boatman	Corixidae	ES
<i>Palmacorixa nana</i>	water boatman	Corixidae	ES
<i>Palmacorixa</i> sp.	water boatman	Corixidae	ES
<i>Pelocoris</i> sp.	creeping water bug	Naucoridae	ES
<i>Peocilocapsus lineatus</i>	four-lined leaf bug	Miridae	CK
<i>Phymata pennsylvanica</i>	ambush bug	Phymatidae	CK
<i>Ranatra fusca</i>	sticklike water scorpion	Nepidae	ES
<i>Ranatra nigra</i>	sticklike water scorpion	Nepidae	ES
<i>Ranatra</i> sp.	sticklike water scorpion	Nepidae	ES,TR
<i>Rhagovelia</i> sp.	small water strider	Veliidae	CK,TR
<i>Rheumatobates</i> sp.	water strider	Gerridae	TR
scutellerid sp.	shield-backed bug	Scutelleridae	ES
<i>Sigara alternata</i>	water boatman	Corixidae	ES
<i>Sigara modesta</i>	water boatman	Corixidae	ES
<i>Sigara</i> sp.	water boatman	Corixidae	CK,ES,TR
<i>Sinea diadema</i>	assassin bug	Reduviidae	CK
<i>Thyanta pallido-virens</i>	green stink bug	Pentatomidae	CK
thyreocorid sp.	negro bug	Thyreocoridae	CK
tingid sp.	lace bug	Tingidae	ES
<i>Trepobates</i> sp.	water strider	Gerridae	CK,ES,TR
<i>Trichocorixa calva</i>	water boatman	Corixidae	ES
<i>Trichocorixa kanza</i>	water boatman	Corixidae	ES
<i>Trichocorixa</i> sp.	water boatman	Corixidae	CK,ES
<i>Zelus exsanguis</i>	assassin bug	Reduviidae	CK
<b>Order Homoptera (cicadas, hoppers, aphids, &amp; scale insects)</b>			
acanaloniid sp.	planthopper	Acanaloniidae	CK
<i>Adelges abeitis</i>	eastern spruce gall adelgid	Adelgidae	CK
<i>Adelges cooleyi</i>	Cooley spruce gall adelgid	Adelgidae	CK
<i>Aphis pomi</i>	green apple aphid	Aphididae	CK
<i>Cacopsylla pyricola</i>	pear psylla	Psyllidae	CK
<i>Daktulosphaira vitifoliae</i>	grape phylloxera	Phylloxeridae	CK
<i>Draeculacephala mollipes</i>	cicadellin leafhopper	Cicadellidae	CK
<i>Dysaphis plantaginea</i>	rosy apple aphid	Aphididae	CK
<i>Empoasca fabae</i>	potato leafhopper	Cicadellidae	CK
<i>Eriosoma lanigerum</i>	wooly aphid	Aphididae	CK
<i>Graphocephala coccinea</i>	colorful leafhopper	Cicadellidae	CK
<i>Melaphis rhois</i> ?	sumac gall	Aphididae	CK
membracid sp.	treehopper	Membracidae	CK,ES
<i>Myzus cerasi</i>	black cherry aphid	Aphididae	CK
<i>Myzus persicae</i>	green peach aphid	Aphididae	CK
<i>Pachypsylla celtidismamma</i>	hackberry nipple gall	Psyllidae	CK
<i>Penthima americana</i>	gyponin leafhopper	Cicadellidae	CK
<i>Periphyllus lyropictus</i>	Norway maple aphid	Aphididae	CK
<i>Philaenus spumarius</i>	meadow spittlebug	Cercopidae	CK
<i>Phylloxera caryaecaulis</i> ?	shag-bark hickory gall	Phylloxeridae	CK
<i>Quadraspidiotus perniciosus</i>	San Jose scale	Diaspididae	CK
<i>Tibicen canicularis</i>	dog day cicada	Cicadidae	CK
<i>Tibicen linnei</i>	dog day cicada	Cicadidae	CK
<i>Typhlocyba pomaria</i>	white apple leafhopper	Cicadellidae	CK

Order Neuroptera (nerve-wing insects)	Common Name	Family	Location
<i>Chauliodes</i> sp.	hellgrammite or fishfly	Corydalidae	CK,ES
<i>Chrysopa oculata</i>	golden eye	Chrysopidae	CK
<i>Climacia</i> sp.	spongillafly	Sisyridae	LE,TR
coniopterygid sp.	dustying	Coniopterygidae	CK
<i>Corydalus cornutus</i>	hellgrammite	Corydalidae	CK,TR
hemerobiid sp.	brown lacewing	Hemerobiidae	CK
<i>Sialis infumata</i>	alderfly	Sialidae	TR
<b>Order Coleoptera (beetles)</b>			
<i>Acalymma vittata?</i>	striped cucumber beetle	Chrysomelidae	CK
<i>Acilius sylvanus</i>	striped diving beetle	Dytiscidae	ES
<i>Acilius</i> sp.	striped diving beetle	Dytiscidae	CK
<i>Agabus</i> sp.	diving beetle	Dytiscidae	CK,ES
<i>Alobates pensylvanica?</i>	darkling beetle	Tenebrionidae	CK
<i>Altica chalybea</i>	grape flea beetle	Chrysomelidae	CK
<i>Anacaena limbata</i>	water scavenger beetle	Hydrophilidae	ES
<i>Ancyronyx</i> sp.	riffle beetle	Elmthidae	TR
<i>Anthicus</i> sp.?	ant-like flower beetle	Anthicidae	CK
<i>Anthrenus scrophulariae?</i>	carpet beetle	Dermestidae	CK
<i>Aphodius</i> sp.	dung beetle	Scarabaeidae	CK
<i>Berosus fraternus</i>	water scavenger beetle	Hydrophilidae	ES
<i>Berosus infuscatus</i>	water scavenger beetle	Hydrophilidae	ES
<i>Berosus peregrinus</i>	water scavenger beetle	Hydrophilidae	ES
<i>Berosus striatus</i>	water scavenger beetle	Hydrophilidae	ES
<i>Berosus</i> sp.	water scavenger beetle	Hydrophilidae	CK
<i>Bidessus</i> sp.	diving beetle	Dytiscidae	ES
<i>Bledius</i> sp.	rove beetle	Staphylinidae	TR
<i>Bolitotherus cornutus</i>	horned fungus beetle	Tenebrionidae	CK
<i>Brachinus</i> sp.?	bombadier ground beetle	Carabidae	CK
brachyrhinin sp.	broad-nosed weevil	Curculionidae	CK
<i>Brontes</i> sp.?	flat bark beetle	Cucujidae	CK
<i>Calathus</i> sp.	ground beetle	Carabidae	CK
<i>Cantharis bilineatus</i>	soldier beetle	Cantharidae	CK
<i>Carpophilus</i> sp.	carpophilin sap beetle	Nitidulidae	CK
cerambycid sp.	locust borer beetle	Cerambycidae	CK
<i>Chauliognathus marginata</i>	soldier beetle	Cantharidae	CK
<i>Chauliognathus pennsylvanicus?</i>	soldier beetle	Cantharidae	CK
<i>Chilocorus stigma</i>	twice-stabbed ladybug	Coccinellidae	CK
<i>Chrysobothris femorata</i>	flat-headed apple tree borer	Buprestidae	CK
<i>Chrysochus auratus</i>	dogbane beetle	Chrysomelidae	CK
<i>Cicindela</i> sp.	tiger beetle	Carabidae	CK
clerid sp.?	checkered beetle	Cleridae	CK
<i>Colaulon</i> sp.	click beetle	Elateridae	CK
<i>Coleomegilla</i> sp.	ladybird beetle	Coccinellidae	CK
<i>Conotrachelus nenuphar</i>	plum curculio	Curculionidae	CK
<i>Copelatus glyphius</i>	diving beetle	Dytiscidae	ES
<i>Copelatus</i> sp.	diving beetle	Dytiscidae	ES
<i>Coptotomus lenticus</i>	diving beetle	Dytiscidae	ES
<i>Creophilus maxillosus</i>	rove beetle	Staphylinidae	CK
<i>Curculio</i> sp.	chestnut weevil	Curculionidae	CK
<i>Curculio</i> sp.	nut weevil	Curculionidae	CK
curculionid sp.	weevil	Curculionidae	CK
<i>Cymbiodyta</i> sp.	water scavenger beetle	Hydrophilidae	ES
<i>Cyphon</i> sp.	marsh beetle	Scirtidae	ES
<i>Cyrtophorus verrucosus</i>	long-horned beetle	Cerambycidae	CK
<i>Dermestes lardarius?</i>	larder beetle	Dermestidae	CK
<i>Derodontus</i> sp.	tooth-necked fungus beetle	Derodontidae	CK
<i>Diabrotica undecimpunctata howardi</i>	spotted cucumber beetle	Chrysomelidae	CK
<i>Dineutus assimilis</i>	whirligig beetle	Gyrinidae	ES
<i>Dineutus</i> sp.	whirligig beetle	Gyrinidae	CK,ES
<i>Disonycha</i> sp.	leaf beetle	Chrysomelidae	CK

Order Coleoptera (cont'd)	Common Name	Family	Location
<i>Donacia</i> sp.	leaf beetle	Chrysomelidae	ES
<i>Dubiraphia bivittata</i>	riffle beetle	Elmthidae	ES
<i>Dubiraphia</i> sp.	riffle beetle	Elmthidae	ES,TR
<i>Dytiscus fasciventris</i>	diving beetle	Dytiscidae	ES
<i>Elaphidionoides</i> sp. [=Elaphidion]	longhorn twig pruner beetle	Cerambycidae	CK
<i>Elaprus ruscarius</i>	marsh or bog beetle	Carabidae	CK
<i>Ellychnia</i> sp.	firefly or lightningbug	Lampyridae	CK
endomychid sp.	handsome fungus beetle	Endomychidae	CK
<i>Enochrus hamiltoni</i>	water scavenger beetle	Hydrophilidae	ES
<i>Enochrus ochraceus</i>	water scavenger beetle	Hydrophilidae	CK,ES
<i>Enochrus perplexus</i>	water scavenger beetle	Hydrophilidae	ES
<i>Enochrus pygmaeus nebulosus</i>	water scavenger beetle	Hydrophilidae	ES
<i>Enochrus sayi</i>	water scavenger beetle	Hydrophilidae	ES
<i>Epicauta</i> sp.	blister beetle	Meloidae	CK
<i>Epilachna varivestis</i>	Mexican bean beetle	Coccinellidae	CK
erotylid sp.?	pleasing fungus beetle	Erotylidae	CK
<i>Euphoria inda</i> ?	bumble flower beetle	Scarabaeidae	CK
<i>Glischrochilus fasciatus</i>	cryptarchin sap beetle	Nitidulidae	CK
<i>Haliphus borealis</i>	crawling water beetle	Haliplidae	ES
<i>Haliphus immaculicollis</i>	crawling water beetle	Haliplidae	ES
<i>Haliphus triopsis</i>	crawling water beetle	Haliplidae	ES,TR
<i>Harmonia axyridis</i>	Asiatic lady beetle	Coccinellidae	CK
<i>Harpalus compar</i>	ground beetle	Carabidae	CK
<i>Harpalus herbivagus</i>	ground beetle	Carabidae	CK
<i>Helichus</i> sp.	long-toed water beetle	Dryopidae	CK,ES
<i>Helophorus lineatus</i>	water scavenger beetle	Hydrophilidae	ES
<i>Helophorus orientalis</i>	water scavenger beetle	Hydrophilidae	ES
<i>Helophorus marginicollis</i>	water scavenger beetle	Hydrophilidae	ES
<i>Helophorus</i> sp.	water scavenger beetle	Hydrophilidae	ES
<i>Heterocerus</i> sp.	variegated mud-loving beetle	Heteroceridae	ES,TR
<i>Heterosternuta wickhami</i>	diving beetle	Dytiscidae	ES
<i>Hippodamia convergens</i> ?	covergent ladybird beetle	Coccinellidae	CK
<i>Hister foedatus</i>	hister beetle	Histeridae	CK
<i>Homaetarsus</i> sp.?	rove beetle	Staphylinidae	CK
<i>Hoplia</i> sp.	grapevine beetle	Scarabaeidae	CK
<i>Hydrobius fuscipes</i>	water scavenger beetle	Hydrophilidae	ES
<i>Hydrocanthus iricolor</i>	burrowing water beetle	Noteridae	ES
<i>Hydrochara leechi</i>	water scavenger beetle	Hydrophilidae	ES
<i>Hydrochara obtusata</i>	water scavenger beetle	Hydrophilidae	TR
<i>Hydrochara</i> sp.	water scavenger beetle	Hydrophilidae	ES
<i>Hydrophilus</i> sp.	water scavenger beetle	Hydrophilidae	TR
<i>Hydroporus niger</i>	diving beetle	Dytiscidae	ES
<i>Hydroporus</i> sp.	diving beetle	Dytiscidae	CK,ES
<i>Hydrovatus</i> sp.	diving beetle	Dytiscidae	CK,ES
<i>Hygrotus dissimilis</i>	diving beetle	Dytiscidae	ES
<i>Hygrotus impressopunctatus</i>	diving beetle	Dytiscidae	ES
<i>Hygrotus sayi</i>	diving beetle	Dytiscidae	ES
<i>Hyperodes</i> sp.	weevil	Curculionidae	TR
<i>Ilybius</i> sp.	diving beetle	Dytiscidae	CK
<i>Laccobius</i> sp.	water scavenger beetle	Hydrophilidae	ES
<i>Laccophilus maculosus maculosus</i>	diving beetle	Dytiscidae	ES
<i>Laccophilus</i> sp.	diving beetle	Dytiscidae	CK
<i>Leptinotarsa decemlineata</i>	Colorado potato beetle	Chrysomelidae	CK
leptodirin sp.	small carrion beetle	Leiodidae	CK
<i>Lucidota atra</i>	firefly or lightningbug	Lampyridae	CK
<i>Lucidota punctata</i>	firefly or lightningbug	Lampyridae	CK
lyctin sp.?	powder-post beetle	Bostrichidae	CK
<i>Lytta aenea</i> ?	blister beetle	Meloidae	CK
<i>Macroductylus subspinosus</i>	rose chafer	Scarabaeidae	CK
<i>Megacyllene robiniae</i>	locust borer	Cerambycidae	CK

Order Coleoptera (cont'd)	Common Name	Family	Location
<i>Melanotus</i> sp.	click beetle	Elateridae	CK
melolonthin sp.	May beetle	Scarabaeidae	CK
melyrid sp.	soft-winged flower beetle	Melyridae	CK
<i>Microcylloepus</i> sp.	riffle beetle	Elmthidae	ES
<i>Neoporus</i> sp.	diving beetle	Dytiscidae	ES
noterid sp.	burrowing water beetle	Noteridae	ES
<i>Oberea bimaculata</i>	raspberry cane borer	Cerambycidae	CK
<i>Odontota dorsalis?</i>	locust leaf beetle	Chrysomelidae	CK
<i>Paederus littorarius</i>	rove beetle	Staphylinidae	CK
<i>Paracymus subcupreus</i>	water scavenger beetle	Hydrophilidae	ES
<i>Parandra brunnea</i>	pole borer	Cerambycidae	CK
<i>Pelidnota punctata</i>	grapevine beetle	Scarabaeidae	CK
<i>Peltodytes duodecimpunctatus</i>	crawling water beetle	Halipidae	ES
<i>Peltodytes edentulus</i>	crawling water beetle	Halipidae	ES
<i>Peltodytes lengi</i>	crawling water beetle	Halipidae	ES
<i>Peltodytes muticus</i>	crawling water beetle	Halipidae	ES
<i>Peltodytes sexmaculatus</i>	crawling water beetle	Halipidae	ES
<i>Peltodytes</i> sp.	crawling water beetle	Halipidae	ES
phalacrid sp.?	shining mold beetle	Phalacridae	CK
<i>Photinus pyralis</i>	firefly or lightningbug	Lampyridae	CK
<i>Photuris pennsylvanica</i>	firefly or lightningbug	Lampyridae	CK
<i>Phyllophaga</i> sp.	June beetle or junebug	Scarabaeidae	CK
<i>Platynus placidus</i>	ground beetle	Carabidae	CK
<i>Podabrus flavicollis?</i>	soldier beetle	Cantharidae	CK
<i>Podabrus modestus?</i>	soldier beetle	Cantharidae	CK
<i>Popilia japonica</i>	Japanese beetle	Scarabaeidae	CK
<i>Psephenus herricki</i>	water-penny beetle	Psephenidae	CK,TR
<i>Pseudolucanus</i> sp.	pinching beetle	Lucanidae	CK
<i>Quedius</i> sp.?	large rove beetle	Staphylinidae	CK
<i>Rhantus</i> sp.	diving beetle	Dytiscidae	CK
salpingid sp.	narrow-waisted bark beetle	Salpingidae	ES
<i>Saprinus</i> sp.	hister beetle	Histeridae	CK
<i>Scarites subterraneus?</i>	ground beetle	Carabidae	CK
<i>Scolytus rugulosus</i>	shot-hole borer	Curculionidae	CK
<i>Silpha americana</i>	carrion beetle	Silphidae	CK
<i>Sphenophorus</i> sp.	billbug weevil	Curculionidae	CK
<i>Staphylinus</i> sp.	rove beetle	Staphylinidae	CK
<i>Stelidiota octomaculata</i>	tiny sap beetle	Nitidulidae	CK
<i>Stenelmis crenata</i>	riffle beetle	Elmthidae	ES
<i>Stenelmis</i> sp.	riffle beetle	Elmthidae	CK,TR
<i>Stenolophus</i> sp.?	ground beetle	Carabidae	CK
<i>Stenus</i> sp.	rove beetle	Staphylinidae	CK,TR
<i>Stethorus punctum</i>	black lady beetle	Coccinellidae	CK
<i>Telephanus velox?</i>	flat bark beetle	Cucujidae	CK
<i>Tetraopes</i> sp.	milkweed beetle	Cerambycidae	CK
thylactin sp.	snout beetle	Curculionidae	CK
<i>Tropisternus lateralis nimbatus</i>	narrow water scavenger beetle	Hydrophilidae	ES,TR
<i>Tropisternus natator</i>	narrow water scavenger beetle	Hydrophilidae	ES
<i>Tropisternus</i> sp.	narrow water scavenger beetle	Hydrophilidae	CK,ES,TR
<i>Xenochalepus dorsalis</i>	locust leafminer	Chrysomelidae	CK
<b>Order Mecoptera (scorpionflies)</b>			
<i>Panorpa helena?</i>	common scorpionfly	Panorpidae	CK
<b>Order Siphonaptera (fleas)</b>			
<i>Ctenocephalides canis</i>	dog flea	Pulicidae	CK
<i>Ctenocephalides felis</i>	cat flea	Pulicidae	CK
<b>Order Diptera (true flies)</b>			
<i>Ablabesmyia parajanta</i>	midge	Chironomidae	ES
<i>Aedes communis?</i>	mosquito	Culicidae	CK

Order Diptera (cont'd)	Common Name	Family	Location
<i>Aedes infirmatus</i>	mosquito	Culicidae	ES
<i>Aedes vexans</i>	mosquito	Culicidae	ES
anthomyzid sp.	anthomyzid fly	Anthomyzidae	CK
<i>Anthrax</i> sp.	bee fly	Bombyliidae	CK
<i>Aphidoletes aphidimyza</i>	orange maggot or gall gnat	Cecidomyiidae	CK
asilid sp.	robber fly	Asilidae	CK
asteiid sp.	asteiid fly	Asteiidae	CK
<i>Atherix variegata</i>	snipe fly	Athericidae	TR
<i>Baccha</i> sp.?	flower fly	Syrphidae	CK
<i>Biblio</i> sp.?	march fly	Bibionidae	CK
blepharocerid sp.	net-winged midge	Blepharoceridae	ES
<i>Brachypremna</i> sp.	crane fly	Tipulidae	CK,TR
<i>Chaoborus flavicans</i>	phantom midge	Chaoboridae	ES
<i>Chaoborus punctipennis</i>	phantom midge	Chaoboridae	ES
<i>Chironomus anthracinus</i>	midge	Chironomidae	ES
<i>Chironomus cristatus</i>	midge	Chironomidae	ES
<i>Chironomus decorus</i>	midge	Chironomidae	ES
<i>Chironomus plumosus</i>	midge	Chironomidae	ES
<i>Chironomus riparus</i>	midge	Chironomidae	ES
<i>Chironomus staegeri</i>	midge	Chironomidae	ES
<i>Chironomus tentans</i>	midge	Chironomidae	ES
chloropid sp.	frit fly	Chloropidae	CK
<i>Chrysops</i> sp.	deer fly	Tabanidae	CK,TR
<i>Cladopelma</i> sp.	midge	Chironomidae	ES
<i>Cladotanytarsus</i> sp.	midge	Chironomidae	ES
<i>Coelotanypus concinnus</i>	midge	Chironomidae	ES
<i>Cricotopus sylvestris</i>	midge	Chironomidae	ES
<i>Cricotopus tremulus</i>	midge	Chironomidae	ES
<i>Cricotopus trifascia</i>	midge	Chironomidae	ES
<i>Cryptochironomus</i> sp.	midge	Chironomidae	ES
<i>Culex pipiens</i>	mosquito	Culicidae	CK
<i>Dicrotendipes nervosus</i>	midge	Chironomidae	ES
<i>Dicrotendipes</i> sp.	midge	Chironomidae	ES
<i>Didea</i> sp.	flower fly	Syrphidae	CK
dolichopodid sp.	long-legged fly	Dolichopodidae	CK
<i>Drosophila melanogaster</i>	pomace fly	Drosophilidae	CK
<i>Endochironomus nigrans</i>	midge	Chironomidae	ES
ephydrid sp.	shore fly	Ephydriidae	CK,ES
<i>Eristalis tenax</i> ?	hover fly	Syrphidae	CK
<i>Eurosta solidaginis</i>	round ball goldenrod gall	Tephritidae	CK
<i>Glyptotendipes loberiferus</i>	midge	Chironomidae	ES
<i>Glyptotendipes</i> sp.	midge	Chironomidae	ES
<i>Hedriodiscus</i> sp.	soldier fly	Stratiomyidae	ES
heleomyzid sp.	heleomyzid fly	Heleomyzidae	CK
<i>Helicobia</i> sp.	flesh fly	Sarcophagidae	CK
<i>Hexatoma</i> sp.	crane fly	Tipulidae	TR
<i>Hydrobaenus</i> sp.	midge	Chironomidae	ES
<i>Labrundinia pilosilla</i>	midge	Chironomidae	ES
lauxaniid sp.	lauxaniid fly	Lauxaniidae	CK
<i>Limnochironomus tenuicadatus</i>	midge	Chironomidae	ES
<i>Limnophyes</i> sp.	midge	Chironomidae	ES
<i>Lipiniella</i> sp.	midge	Chironomidae	ES
lonchopterid sp.	spear-winged fly	Lonchpoteridae	ES
<i>Lucilia illustris</i> ?	blow fly	Calliphoridae	CK
<i>Merycomia</i> sp.	horse fly	Tabanidae	TR
<i>Microchironomus</i> sp.	midge	Chironomidae	ES
<i>Micropsectra polita</i>	midge	Chironomidae	ES
<i>Microtendipes caelum</i>	midge	Chironomidae	ES
<i>Musca</i> sp.	house fly	Muscidae	CK
mycetophilid sp.	fungus gnat	Mycetophilidae	CK,ES



	Common Name	Family	Location
<b>Order Diptera (cont'd)</b>			
<i>Odontomyia</i> sp.	soldier fly	Stratiomyidae	ES
<i>Orthocladius obumbratus</i>	midge	Chironomidae	ES
<i>Orthocladius</i> sp.	midge	Chironomidae	ES
<i>Parachironomus</i> sp.	midge	Chironomidae	ES
<i>Paradelphomyia</i> sp.	crane fly	Tipulidae	TR
<i>Paralauterborniella</i> sp.	midge	Chironomidae	ES
<i>Paratanytarsus</i> sp.	midge	Chironomidae	ES
<i>Paratendipes</i> sp.	midge	Chironomidae	ES
<i>Pedicia</i> sp.	crane fly	Tipulidae	TR
<i>Pentaneura</i> sp.	midge	Chironomidae	ES
phorid sp.	humpbacked fly	Phoridae	CK,ES
<i>Pollenia</i> sp.?	cluster blow fly	Calliphoridae	CK
<i>Polypedilum halterale</i>	midge	Chironomidae	ES
<i>Polypedilum</i> sp.	midge	Chironomidae	ES
<i>Pothastia longimanus</i>	midge	Chironomidae	ES
<i>Probezzia</i> sp.	biting midge	Ceratopogonidae	ES
<i>Procladius</i> sp.	midge	Chironomidae	ES
<i>Procladius sublettei</i>	midge	Chironomidae	ES
<i>Protoplasa</i> sp.?	primitive crane fly	Tanyderidae	CK
ptychopterid sp.	phantom crane fly	Ptychopteridae	CK
<i>Rhagio</i> sp.	snipe fly	Rhagionidae	CK
<i>Rhagoletis pomonella</i>	apple maggot	Tephritidae	CK
<i>Rheotanytarsus exiguus</i>	midge	Chironomidae	ES
<i>Rhopalomyia solidaginis</i>	leafy goldenrod gall	Cecidomyiidae	CK
sciarid sp.	dark-winged fungus gnat	Sciaridae	CK
sciomyzid sp.	marsh fly	Sciomyzidae	ES
<i>Simulium</i> sp.	black fly	Simuliidae	CK,ES
<i>Spoggosia</i> sp.?	tachina fly	Tachinidae	CK
<i>Stictochironomus</i> sp.	midge	Chironomidae	ES
<i>Stratiomys</i> sp.	soldier fly	Stratiomyidae	CK
<i>Sympothastia</i> sp.	midge	Chironomidae	ES
<i>Syrphus</i> sp.	hover fly	Syrphidae	CK
<i>Tabanus</i> sp.	horse fly	Tabanidae	CK,TR
<i>Tanypus</i> sp.	midge	Chironomidae	ES,TR
<i>Tanytarsus glabrescens</i>	midge	Chironomidae	ES
therevid sp.	stiletto fly	Therevidae	CK
<i>Thienemannimyia</i> sp.	midge	Chironomidae	ES
<i>Tipula</i> sp.	crane fly	Tipulidae	CK,ES,TR
<i>Tribelos</i> sp.	midge	Chironomidae	ES
<i>Trichocera</i> sp.?	winter crane fly	Trichoceridae	CK
<b>Order Trichoptera (caddisflies)</b>			
<i>Agraylea</i> sp.	caddisfly	Hydroptilidae	CK,ES
<i>Ceraclea cancellatus</i>	caddisfly	Leptoceridae	CK
<i>Ceraclea resurgens</i>	caddisfly	Leptoceridae	CK
<i>Ceraclea tarsi-punctata</i>	caddisfly	Leptoceridae	CK,ES
<i>Ceraclea transversus</i>	caddisfly	Leptoceridae	ES
<i>Ceraclea</i> sp.	caddisfly	Leptoceridae	CK
<i>Ceratopsyche bronta</i>	caddisfly	Hydropsychidae	ES
<i>Ceratopsyche slossonae</i>	caddisfly	Hydropsychidae	ES
<i>Ceratopsyche</i> sp.	caddisfly	Hydropsychidae	ES,TR
<i>Cernotina ohio</i>	caddisfly	Polycentropodidae	ES
<i>Cheumatopsyche burksi</i>	caddisfly	Hydropsychidae	ES
<i>Cheumatopsyche campyla</i>	caddisfly	Hydropsychidae	CK
<i>Cheumatopsyche minuscula</i>	caddisfly	Hydropsychidae	ES
<i>Cheumatopsyche pasella</i>	caddisfly	Hydropsychidae	ES
<i>Cheumatopsyche sordida</i>	caddisfly	Hydropsychidae	CK,ES
<i>Cheumatopsyche</i> sp.	caddisfly	Hydropsychidae	ES,TR
<i>Chimarra obscura</i>	caddisfly	Philopotamidae	CK,ES
<i>Cyrnellus fraternus</i>	caddisfly	Polycentropodidae	CK,ES
<i>Cyrnellus marginalis</i>	caddisfly	Polycentropodidae	ES

<b>Order Trichoptera (cont'd)</b>	<b>Common Name</b>	<b>Family</b>	<b>Location</b>
<i>Helicopsyche</i> sp.	caddisfly	Helicopsychidae	TR
<i>Hydropsyche betteni</i>	caddisfly	Hydropsychidae	CK,ES
<i>Hydropsyche recurvata</i>	caddisfly	Hydropsychidae	CK,ES
<i>Hydropsyche</i> sp.	caddisfly	Hydropsychidae	CK,ES,TR
<i>Hydropsyche walkeri</i>	caddisfly	Hydropsychidae	CK
<i>Hydroptila ajax</i>	caddisfly	Hydroptilidae	CK,ES
<i>Hydroptila angusta</i>	caddisfly	Hydroptilidae	CK
<i>Hydroptila armata</i>	caddisfly	Hydroptilidae	ES
<i>Hydroptila consimilis</i>	caddisfly	Hydroptilidae	ES
<i>Hydroptila grandiosa</i>	caddisfly	Hydroptilidae	CK
<i>Hydroptila perdita</i>	caddisfly	Hydroptilidae	CK,ES
<i>Hydroptila spatulata</i>	caddisfly	Hydroptilidae	CK
<i>Hydroptila waubesiana</i>	caddisfly	Hydroptilidae	CK,ES
<i>Leptocerus americanus</i>	caddisfly	Leptoceridae	CK
<i>Limnephilus submonilifer</i>	caddisfly	Limnephilidae	CK
<i>Nectopsyche</i> sp.	caddisfly	Leptoceridae	CK,ES
<i>Neophylax</i> sp.	caddisfly	Limnephilidae	CK
<i>Neureclipsis crepuscularis</i>	caddisfly	Polycentropodidae	ES
<i>Nyctiophylax moestus</i>	caddisfly	Polycentropodidae	CK,ES
<i>Ochrotrichia tarsalis</i>	caddisfly	Hydroptilidae	CK,ES
<i>Oecetis avara</i>	caddisfly	Leptoceridae	ES
<i>Oecetis cinerascens</i>	caddisfly	Leptoceridae	CK,ES
<i>Oecetis inconspicua</i>	caddisfly	Leptoceridae	CK,ES
<i>Oecetis persimilus</i>	caddisfly	Leptoceridae	CK
<i>Orthotrichia americana</i>	caddisfly	Hydroptilidae	CK,ES
<i>Oxythira pallida</i>	caddisfly	Hydroptilidae	ES
<i>Philarctus</i> sp.?	caddisfly	Limnephilidae	ES
<i>Phryganea cinerea</i>	caddisfly	Phryganeidae	ES
<i>Polycentropus interruptus</i>	caddisfly	Polycentropodidae	ES
<i>Polycentropus aureolus</i>	caddisfly	Polycentropodidae	CK
<i>Polycentropus cinereus</i>	caddisfly	Polycentropodidae	CK
<i>Polycentropus crassicornis</i>	caddisfly	Polycentropodidae	ES
<i>Potamyia</i> sp.	caddisfly	Hydropsychidae	CK,TR
<i>Pycnopsyche</i> sp.	caddisfly	Limnephilidae	TR
<i>Rhyacophila ledra</i>	caddisfly	Rhyacophilidae	CK
<i>Rhyacophila vibox</i>	caddisfly	Rhyacophilidae	CK
<i>Triaenodes frontalis</i>	caddisfly	Leptoceridae	ES
<b>Order Lepidoptera (butterflies &amp; moths)</b>			
<i>Alypia</i> sp.	forester moth	Agaristidae	CK
<i>Antheraea polyphemus</i>	polyphemus moth	Saturniidae	CK
<i>Archips argyrospila</i>	fruittree leaf-roller	Tortricidae	CK
<i>Argyrotaenia velutinana</i>	red-banded leaf-roller	Tortricidae	CK
<i>Asterocampa celtis</i>	hackberry butterfly	Nymphalidae	CK
<i>Asterocampa clyton</i>	tawny emperor	Nymphalidae	CK
<i>Autographa</i> sp.	looper moth	Noctuidae	CK
<i>Automeris io</i>	io moth	Saturniidae	CK
<i>Battus philenor</i>	pipevine swallowtail	Papilionidae	CK
<i>Boloria bellona bellona</i>	meadow fritillary	Nymphalidae	CK
<i>Catocala</i> sp.	underwing moth	Noctuidae	CK
<i>Celastrina ladon ladon</i>	spring azure	Lycanidae	CK
<i>Cercyonis pegala</i>	common wood nymph	Satyridae	CK
<i>Choristoneura rosaceana</i>	oblique-banded leaf-roller	Tortricidae	CK
<i>Colias eurytheme</i>	orange sulfur	Pieridae	CK
<i>Colias philodice</i>	common sulfur	Pieridae	CK
<i>Crambus</i> sp.	close-wings or grass moth	Pyralidae	CK
<i>Ctenucha virginica</i>	ctenuchid Virginia moth	Ctenuchidae	CK
<i>Cydia pomonella</i>	codling moth	Tortricidae	CK
<i>Danaus plexippus</i>	monarch butterfly	Danaidae	CK
<i>Enodia anhedon</i>	northern pearly eye	Nymphalidae	CK
<i>Epargyreus clarus</i>	silver-spotted skipper	Hesperiidae	CK

Order Lepidoptera (cont'd)	Common Name	Family	Location
<i>Erynnis baptisiae</i>	wild indigo duskywing skipper	Hesperiidae	CK
<i>Estigmene</i> sp.?	white moth	Arctiidae	CK
<i>Euchoeca albovitata</i>	white-striped black moth	Geometridae	CK
<i>Euzophera semifuneralis</i>	American plum borer	Pyralidae	CK
<i>Everes comyntas</i>	eastern tailed blue	Lycanidae	CK
<i>Gnorimoschema gallaesolidaginis</i>	golden rod gall	Gelechiidae	CK
<i>Grapholitha molesta</i>	Oriental fruit moth	Tortricidae	CK
<i>Haemotopis grataria</i>	chickweed geometer moth	Geometridae	CK
<i>Heliothis zea</i>	corn earworm	Noctuidae	CK
<i>Hemerocampa leucostigma</i>	white-marked tussock moth	Lymantriidae	CK
<i>Hyphantria cunea</i>	fall webworm	Arctiidae	CK
<i>Isia isabella</i>	banded woollybear	Arctiidae	CK
<i>Junonia coenia</i>	buckeye	Nymphalidae	CK
<i>Libytheana bachmanii</i>	snout butterfly	Libytheidae	CK
<i>Limenitis archippus</i>	viceroy	Nymphalidae	CK
<i>Limenitis arthemis astyanax</i>	red-spotted purple	Nymphalidae	CK
<i>Lycaena phlaeas</i>	American copper	Lycanidae	CK
<i>Malacosoma americanum</i>	eastern tent caterpillar	Lasiocampidae	CK
<i>Manduca quinque maculata</i>	tomato hornworm	Sphingidae	CK
<i>Megisto cymela</i>	little wood satyr	Satyridae	CK
notodontid sp.	prominent moth	Notodontidae	CK
<i>Nymphalis antiopa</i>	mourning cloak	Nymphalidae	CK
<i>Nymphalis milberti</i>	Milbert's tortoise shell	Nymphalidae	CK
<i>Ostrinia nubilalis</i>	European corn borer	Pyralidae	CK
<i>Papaipema nebris</i>	stalk borer	Noctuidae	CK
<i>Papilio cresphontes</i>	giant swallowtail	Papilionidae	CK
<i>Papilio glaucus</i>	tiger swallowtail	Papilionidae	CK
<i>Papilio polyxenes asterius</i>	black swallowtail	Papilionidae	CK
<i>Papilio troilus</i>	spicebush swallowtail	Papilionidae	CK
<i>Paralobesia viteana</i>	grape berry moth	Tortricidae	CK
<i>Pennisetia marginata</i>	raspberry crown borer	Sesiidae	CK
<i>Pholisora catullus</i>	common sootywing skipper	Hesperiidae	CK
<i>Phyciodes tharos</i>	pearl crescent	Nymphalidae	CK
<i>Phyllonorycter blancardella</i>	spotted tentiform leafminer	Gracillariidae	CK
<i>Pieris rapae</i>	cabbage white	Pieridae	CK
<i>Platy nota flavedana</i>	variegated leaf-roller	Tortricidae	CK
<i>Platynota idaeusalis</i>	tufted apple bud-moth	Tortricidae	CK
<i>Platysamia cecropia</i>	cecropia moth	Saturniidae	CK
<i>Plodia interpunctata</i>	Indian meal moth	Pyralidae	CK
<i>Poanes zabulon</i>	southern golden skipper	Hesperiidae	CK
<i>Podosesia syringae syringae</i>	lilac borer	Sesiidae	CK
<i>Polites coras</i> [= <i>Polites peckius</i> ]	yellowpatch or Peck's skipper	Hesperiidae	CK
<i>Polygonia interrogationis</i>	question-mark	Nymphalidae	CK
<i>Protoparce sexta</i> ?	sphinx moth	Sphingidae	CK
<i>Speyeria</i> sp.	fritillary or silverspot	Nymphalidae	CK
sphingid sp.	clear-wing sphinx moth	Sphingidae	CK
<i>Spilonota ocellana</i>	eye-spotted bud-moth	Tortricidae	CK
<i>Synanthedon exitiosa</i>	peach tree borer	Sesiidae	CK
<i>Synanthedon pictipes</i>	lesser peach tree borer	Sesiidae	CK
<i>Synanthedon scitula</i>	dogwood borer	Sesiidae	CK
<i>Synchlora aerata</i>	green geometrid moth	Geometridae	CK
tineid sp.	clothes moth	Tineidae	CK
<i>Vanessa atalanta rubria</i>	red admiral	Nymphalidae	CK
<i>Vanessa cardui</i>	painted lady	Nymphalidae	CK
<i>Vanessa virginiensis</i>	American painted lady	Nymphalidae	CK
yponomeutoid sp.	ermine moth	Yponomeutoidea	ES
<b>Order Hymenoptera (ants, bees, sawflies, &amp; wasps)</b>			
<i>Acanthomyops</i> sp.	foundation ant	Formicidae	CK
<i>Agapostemon</i> sp.	halictid bee	Halictidae	CK

Order Hymenoptera (cont'd)	Common Name	Family	Location
<i>Amphibolips</i> sp.?	oak apple gall	Cynipidae	CK
andrenid sp.	andrenid bee	Andrenidae	CK
anthophorid sp.	digger bee	Anthophoridae	CK
<i>Apis mellifera</i>	honey bee	Apidae	CK
<i>Bombus</i> sp.	large bumblebee	Apidae	CK
braconid sp.	braconid wasp	Braconidae	CK
<i>Camponotus</i> sp.	carpenter ant	Formicidae	CK
<i>Chalybion</i> sp.?	thread-waisted wasp	Sphecidae	CK
chrysidid sp.	cuckoo wasp	Chrysididae	CK
colletid sp.	colletid bee	Colletidae	CK
<i>Crematogaster</i> sp.	small black ant	Formicidae	CK
<i>Diastrophus cuscutaeformis</i>	blackberry gall	Cynipidae	CK
<i>Diastrophus nebulosis</i>	blackberry gall-maker	Cynipidae	CK
<i>Eumenes</i> sp.?	potter wasp	Eumenidae	CK
eurytomid sp.	chalid seed wasp	Eurytomidae	CK
evaniid sp.	ensign wasp	Evaniidae	ES
<i>Formica</i> sp.	mound builder ant	Formicidae	CK
halictid sp.	halictid bee	Halictidae	CK
ichneumonid sp.	ichneumon wasp	Ichneumonidae	CK,ES
<i>Lasius</i> sp.	winged ant	Formicidae	CK
<i>Leptothorax</i> sp.	ant	Formicidae	CK
megachilid sp.	leafcutting bee	Megachilidae	CK
<i>Megarhyssa</i> sp.?	ichneumon wasp	Ichneumonidae	CK
<i>Monobia</i> sp.?	potter wasp	Eumenidae	CK
<i>Monomorium pharaonis</i> ?	Pharaoh ant	Formicidae	CK
<i>Myrmica</i> sp.	ant	Formicidae	CK
nomadin sp.?	cuckoo bee	Anthophoridae	CK
polistin sp.	paper wasp	Vespidae	CK
<i>Ponera</i> sp.	ant	Formicidae	CK
<i>Prenolepis</i> sp.	ant	Formicidae	CK
proctotrupid sp.	parasitic wasp	Proctotrupidae	CK
<i>Sphecius speciosus</i>	cicada killer wasp	Sphecidae	CK
tenthredinid sp.	sawfly	Tenthredinidae	CK
<i>Tetramorium caespitum</i>	pavement ant	Formicidae	CK
tiphiid sp.	tiphiid wasp	Tiphiidae	CK,ES
torymid sp.	parasitic wasp	Torymidae	CK
<i>Tremex</i> sp.?	horntail sawfly	Siricidae	CK
<i>Vespa crabro germana</i>	giant hornet	Vespidae	CK
<i>Vespula germanica</i>	picnic wasp	Vespidae	CK
<i>Vespula maculata</i>	bald-faced hornet	Vespidae	CK
<i>Vespula maculifrons</i> ?	yellowjacket wasp	Vespidae	CK
<i>Xylocopa virginica</i> ?	large carpenter bee	Anthophoridae	CK

## PHYLUM TARDIGRADA (water bears)

<b>Order Eutardigrada</b>			
macrobiotid sp.	water bear	Macrobiotidae	ES

## PHYLUM BRYOZOA [=ECTOPROCTA] (bryozoans)

## CLASS PHYLACTOLAEMATA

## Order Plumatellida

<i>Lophopodella carteri</i>	sac bryozoan	Lophopodidae	ES
<i>Pectinatella magnifica</i>	slimy bryozoan	Lophopodidae	ES
<i>Plumatella casmiana</i>	bryozoan	Plumatellidae	ES
<i>Plumatella repens</i>	spreading bryozoan	Plumatellidae	ES

## Location Codes:

CK – Old Woman Creek watershed upstream of the estuary

ES – Old Woman Creek Estuary (including watershed within boundaries of NERR)

LE – Lake Erie, principally nearshore waters of Erie County and western Lorain County, Ohio

TR – Tributary watersheds to Lake Erie other than Old Woman Creek, principally of eastern Erie County and western Lorain County, Ohio

**APPENDIX D. FISH FAUNA OF OLD WOMAN CREEK ESTUARY AND WATERSHED,  
AND ADJACENT TRIBUTARIES AND WATERS OF LAKE ERIE**

	Common Name	Location
<b>LAMPREYS (Petromyzontidae)</b>		
<i>Ichthyomyzon unicuspis</i>	silver lamprey	LE,TR
<i>Petromyzon marinus</i>	sea lamprey	LE
<b>STURGEONS (Acipenseridae)</b>		
<i>Acipenser fulvescens</i>	lake sturgeon	LE
<b>GARS (Lepisosteidae)</b>		
<i>Lepisosteus osseus</i>	longnose gar	ES,LE,TR
<b>BOWFINS (Ammidae)</b>		
<i>Amia calva</i>	bowfin	ES,LE,TR
<b>HERRINGS (Clupeidae)</b>		
<i>Alosa pseudoharengus</i>	alewife	ES,LE,TR
<i>Dorosoma cepedianum</i>	gizzard shad	ES,LE,TR
<b>WHITEFISHES (Coregoninae)</b>		
<i>Coregonus clupeaformis</i>	lake whitefish	LE
<b>MOONEYES (Hiodontidae)</b>		
<i>Hiodon tergisus</i>	mooneye	LE
<b>SALMONS AND TROUTS (Salmoninae)</b>		
<i>Oncorhynchus kisutch</i>	coho salmon	ES,LE,TR
<i>Oncorhynchus tshawytscha</i>	chinook salmon	LE,TR
<i>Oncorhynchus maykiss</i>	rainbow or steelhead trout	CK,ES,LE,TR
<i>Salvelinus fontinalis</i>	brook trout	TR
<i>Salmo trutta</i>	brown trout	TR
<b>SMELTS (Osmeridae)</b>		
<i>Osmerus mordax</i>	rainbow smelt	LE
<b>MUDMINNOWS (Umbridae)</b>		
<i>Umbra limi</i>	central mudminnow	ES,TR
<b>PIKES (Esocidae)</b>		
<i>Esox americanus</i>	grass pickerel	TR
<i>Esox lucius</i>	northern pike	CK,ES,LE,TR
<i>Esox masquinongy</i>	muskellunge	LE
<i>Esox niger</i>	chain pickerel	TR
<b>CARPS AND MINNOWS (Cyprinidae)</b>		
<i>Campostoma anomalum</i>	stoneroller minnow	CK,ES,TR
<i>Carassius auratus</i>	goldfish	ES,LE,TR
<i>Clinostomus elongatus</i>	redundant dace	LE,TR
<i>Cyprinella spiloptera</i>	spotfin shiner	ES,LE,TR
<i>Cyprinus carpio</i>	common carp	ES,LE,TR
<i>Hybopsis amblops</i>	bigeye chub	TR
<i>Hybopsis storeriana</i>	silver chub	ES,LE,TR
<i>Luxilus chrysocephalus</i>	striped shiner	LE,TR
<i>Luxilus cornutus</i>	common shiner	CK,ES,TR
<i>Lythrurus umbratilis</i>	redfin shiner	TR
<i>Nocomis biguttatus</i>	hornyhead chub	TR
<i>Nocomis micropogon</i>	river chub	TR
<i>Notemigonus crysoleucas</i>	golden shiner	ES,LE,TR
<i>Notropis atherinoides</i>	emerald shiner	CK,ES,LE,TR
<i>Notropis buccata</i>	silverjaw minnow	LE,TR
<i>Notropis buechanani</i>	ghost shiner	LE,TR
<i>Notropis dorsalis</i>	bigmouth shiner	TR

**CARPS AND MINNOWS (cont'd)**

	Common Name	Location
<i>Notropis emiliae</i>	pugnose minnow	TR
<i>Notropus heterolepis</i>	blacknose shiner	LE
<i>Notropis hudsonius</i>	spottail shiner	ES,LE,TR
<i>Notropis photogenis</i>	silver shiner	TR
<i>Notropis rubellus</i>	rosyface shiner	ES,TR
<i>Notropis stramineus</i>	sand shiner	ES,LE,TR
<i>Notropis volucellus</i>	mimic shiner	LE,TR
<i>Phoxinus erythrogaster</i>	southern redbelly dace	TR
<i>Pimephales notatus</i>	bluntnose minnow	CK,ES,LE,TR
<i>Pimephales promelas</i>	northern fathead minnow	ES,TR
<i>Rhinichthys atratulus</i>	blacknose dace	CK,TR
<i>Rhinichthys cataractae</i>	longnose dace	LE
<i>Semotilus atromaculatus</i>	northern creek chub	ES,CK,TR

**SUCKERS (Catostomidae)**

<i>Carpionodes cyprinus</i>	quillback carpsucker	ES,LE,TR
<i>Catostomus commersoni</i>	white sucker	CK,ES,LE,TR
<i>Hypentelium nigricans</i>	northern hog sucker	LE,TR
<i>Ictiobus bubalus</i>	smallmouth buffalo	ES,LE,TR
<i>Ictiobus cyprinellus</i>	bigmouth buffalo	LE,TR
<i>Minytrema melanops</i>	spotted sucker	ES,LE,TR
<i>Moxostoma anisurum</i>	silver redhorse	LE,TR
<i>Moxostoma duquesnei</i>	black redhorse	ES,LE,TR
<i>Moxostoma erythrurum</i>	golden redhorse	ES,LE,TR
<i>Moxostoma macrolepidotum</i>	shorthead redhorse	ES,LE,TR

**BULLHEAD CATFISHES (Ictaluridae)**

<i>Ameiurus melas</i>	black bullhead	ES,TR
<i>Ameiurus natalis</i>	yellow bullhead	ES,LE,TR
<i>Ameiurus nebulosus</i>	brown bullhead	ES,LE,TR
<i>Ictalurus punctatus</i>	channel catfish	ES,LE,TR
<i>Noturus flavus</i>	stonecat madtom	ES,LE,TR
<i>Noturus gyrinus</i>	tadpole madtom	ES,TR
<i>Noturus miurus</i>	brindled madtom	LE,TR
<i>Pylodictis olivaris</i>	flathead catfish	LE,TR

**TROUT-PERCHES (Percopsidae)**

<i>Percopsis olincomaycus</i>	trout-perch	LE,TR
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**CODFISHES (Gadidae)**

<i>Lota lota</i>	burbot	LE
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**KILLIFISHES (Cyprinodontidae)**

<i>Fundulus diaphanus menona</i>	western banded killifish	TR
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**SILVERSIDES (Poecillidae)**

<i>Labidesthes sicculus</i>	brook silverside	ES,LE,TR
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**TEMPERATE BASSES (Percichthyidae)**

<i>Morone americana</i>	white perch	ES,LE,TR
<i>Morone chrysops</i>	white bass	ES,LE,TR

**SUNFISHES (Centrarchidae)**

<i>Ambloplites rupestris</i>	rock bass	LE,TR
<i>Lepomis cyanellus</i>	green sunfish	CK,ES,LE,TR
<i>Lepomis gibbosus</i>	pumpkinseed	CK,ES,LE,TR
<i>Lepomis humilis</i>	orangespotted sunfish	ES,TR
<i>Lepomis macrochirus</i>	bluegill sunfish	ES,LE,TR
<i>Lepomis megalotis peltastes</i>	northern longear sunfish	TR
<i>Micropterus dolomieu</i>	smallmouth bass	ES,LE,TR
<i>Micropterus salmoides</i>	largemouth bass	CK,ES,LE,TR
<i>Pomoxis annularis</i>	white crappie	ES,LE,TR
<i>Pomoxis nigromaculatus</i>	black crappie	ES,LE,TR

	Common Name	Location
<b>PERCHES (Percidae)</b>		
<i>Ammocrypta pellucida</i>	eastern sand darter	LE,TR
<i>Etheostoma blennioides</i>	greenside darter	TR
<i>Etheostoma caeruleum</i>	rainbow darter	CK,LE,TR
<i>Etheostoma exile</i>	Iowa darter	LE,TR
<i>Etheostoma flabellare</i>	fantail darter	LE,TR
<i>Etheostoma nigrum</i>	johnny darter	ES,TR
<i>Perca flavescens</i>	yellow perch	ES,LE,TR
<i>Percina caprodes</i>	logperch darter	ES,LE,TR
<i>Percina copelandi</i>	channel darter	LE,TR
<i>Percina maculata</i>	blackside darter	TR
<i>Stizostedion canadense</i>	sauger	LE
<i>Sander vitreus vitreus</i>	walleye	ES,LE,TR
<b>DRUMS (Sclaeinidae)</b>		
<i>Aplodinotus grunniens</i>	freshwater drum	ES,LE,TR
<b>SCULPINS (Cottidae)</b>		
<i>Cottus bairdi</i>	mottled sculpin	LE,TR

**Location Codes:**

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**APPENDIX E. AVIFAUNA OF OLD WOMAN CREEK ESTUARY, WATERSHED,  
AND ADJACENT TRIBUTARIES AND WATERS OF LAKE ERIE**

	Common Name	—Abundance—			
		Sp	Su	F	W
<b>LOONS (Gaviidae)</b>					
<i>Gavia immer</i>	common loon	U	R	U	O
<i>Gavia stellata</i>	red-throated loon	O		O	R
<b>GREBES (Podicipedidae)</b>					
<i>Podiceps auritus</i>	horned grebe	U		U	O
<i>Podiceps grisegena</i>	red-necked grebe	R		R	R
<i>Podiceps nigricollis</i>	eared grebe	R		R	R
<i>Podilymbus podiceps</i>	pied-billed grebe	C	U	C	O
<b>CORMORANTS (Phalacrocoracidae)</b>					
<i>Phalacrocorax auritus</i>	double-crested cormorant	C	C	C	R
<b>HERONS (Ardeidae)</b>					
<i>Ardea albus</i>	great egret [=common heron]	U	U	O	
<i>Ardea herodias</i>	great blue heron	C	C	C	O
<i>Botaurus lentiginosus</i>	American bittern	R	R	R	
<i>Bubulcus ibis</i>	cattle egret	R	R	R	
<i>Butorides striatus</i>	striated heron [=green-backed heron]	U	U	U	
<i>Egretta thula</i>	snowy egret	R	R	R	
<i>Ixobrychus exilis</i>	least bittern	R	R	R	
<i>Nyctanassa violacea</i>	yellow-crowned night-heron	R	R	R	
<i>Nycticorax nycticorax</i>	black-crowned night-heron	U	U	U	R
<b>WATERFOWL: DUCKS, GEESE, &amp; SWANS (Anatidae)</b>					
<i>Aix sponsa</i>	wood duck	C	C	C	R
<i>Anas acuta</i>	northern pintail	O	R	O	O
<i>Anas americana</i>	American wigeon	O	R	O	O
<i>Anas clypeata</i>	northern shoveler	O	R	O	R
<i>Anas crecca</i>	green-winged teal	O	R	O	R
<i>Anas discors</i>	blue-winged teal	U	U	U	R
<i>Anas platyrhynchos</i>	mallard	A	A	A	A
<i>Anas rubripes</i>	American black duck	C	U	C	C
<i>Anas strepera</i>	gadwall	U	R	U	O
<i>Aythya affinis</i>	lesser scaup	C	R	C	C
<i>Aythya americana</i>	redhead	U	R	U	O
<i>Aythya collaris</i>	ring-necked duck	U	R	U	O
<i>Aythya marila</i>	greater scaup	U		U	U
<i>Aythya valisineria</i>	canvasback	U		U	O
<i>Branta canadensis</i>	Canada goose	C	C	A	C
<i>Bucephala albeola</i>	bufflehead	C		C	U
<i>Bucephala clangula</i>	common goldeneye	C		C	C
<i>Chen caerulescens</i>	snow goose	R		O	R
<i>Clangula hyemalis</i>	oldsquaw	O		O	O
<i>Cygnus columbianus</i>	tundra swan [= whistling swan]	U		U	R
<i>Cygnus olor</i>	mute swan	R		R	R
<i>Lophodytes cucullatus</i>	hooded merganser	U	R	U	U
<i>Melanitta fusca</i>	white-winged scoter	O		O	U
<i>Melanitta nigra</i>	black scoter	R		O	R
<i>Melanitta perspicillata</i>	surf scoter	R		O	R
<i>Mergus merganser</i>	common merganser	O		O	U
<i>Mergus serrator</i>	red-breasted merganser	C	R	A	C
<i>Oxyura jamaicensis</i>	ruddy duck	C	R	C	R



	Common Name	Abundance			
		Sp	Su	F	W
<b>AMERICAN VULTURES (Cathartidae)</b>					
<i>Cathartes aura</i>	turkey vulture	C	C	C	
<b>BIRDS OF PREY: OSPREYS: (Accipitridae: Panioninae)</b>					
<i>Pandion haliaetus</i>	osprey	U	R	U	
<b>BIRDS OF PREY: HAWKS &amp; EAGLES (Accipitridae: Accipitrinae)</b>					
<i>Accipiter cooperii</i>	Cooper's hawk	U	U	U	U
<i>Accipiter gentilis</i>	northern goshawk	R		R	R
<i>Accipiter striatus</i>	sharp-shinned hawk	U	R	U	R
<i>Buteo jamaicensis</i>	red-tailed hawk	C	C	C	C
<i>Buteo lagopus</i>	rough-legged hawk	O		O	C
<i>Buteo lineatus</i>	red-shouldered hawk	U	R	U	R
<i>Buteo platypterus</i>	broad-winged hawk	U	R	U	
<i>Circus cyaneus</i>	northern harrier [= marsh hawk]	U	R	U	U
<i>Falco columbarius</i>	merlin	O		O	
<i>Falco peregrinus</i>	peregrine falcon	O	R	O	R
<i>Falco sparverius</i>	American kestrel [=sparrow hawk]	C	C	C	C
<i>Haliaeetus leucocephalus</i>	bald eagle	C	C	C	C
<b>GALLINACEOUS BIRDS: PHEASANTS &amp; QUAILS (Phasianidae)</b>					
<i>Colinus virginianus</i>	northern bobwhite	R	R	R	R
<i>Meleagris gallopavo</i>	wild turkey	O	O	O	O
<i>Phasianus colchicus</i>	ring-necked pheasant	R	R	R	R
<b>RAILS (Rallidae)</b>					
<i>Fulica americana</i>	American coot	U	U	U	U
<i>Gallinula chloropus</i>	common moorhen	O	O	O	
<i>Porzana carolina</i>	sora	U	O	U	
<i>Rallus elegans</i>	king rail	R	R	R	
<i>Rallus limicola</i>	Virginia rail	O	O	O	
<b>SHOREBIRDS: PLOVERS (Charadriidae)</b>					
<i>Charadrius melodus</i>	piping plover	R	R	R	
<i>Charadrius semipalmatus</i>	semipalmated plover	U	U	U	
<i>Charadrius vociferus</i>	killdeer	C	C	C	R
<i>Pluvialis dominica</i>	American golden-plover	U	R	U	
<i>Pluvialis squatarola</i>	black-bellied plover	U	O	U	
<b>SHOREBIRDS: SANDPIPERS &amp; ALLIES (Scolopacidae)</b>					
<i>Actitis macularia</i>	spotted sandpiper	C	C	C	
<i>Arenaria interpres</i>	ruddy turnstone	U	O	U	R
<i>Bartramia longicauda</i>	upland sandpiper	R	R	R	
<i>Calidris alba</i>	sanderling	U	O	U	
<i>Calidris alpina</i>	dunlin	A	O	C	R
<i>Calidris canutus</i>	red knot	O	O	O	
<i>Calidris fuscicollis</i>	white-rumped sandpiper	O	O	O	
<i>Calidris himantopus</i>	stilt sandpiper	O	O	O	
<i>Calidris maritima</i>	purple sandpiper			O	O
<i>Calidris mauri</i>	western sandpiper	O	U	U	
<i>Calidris melanotos</i>	pectoral sandpiper	C	U	C	
<i>Calidris minutilla</i>	least sandpiper	C	U	C	
<i>Calidris pusilla</i>	semipalmated sandpiper	C	U	C	
<i>Catoptrophorus semipalmatus</i>	willet	O	R	O	
<i>Gallinago gallinago</i>	common snipe	U	O	U	
<i>Limnodrolus scolopaceus</i>	long-billed dowitcher	R	R	U	
<i>Limnodromus griseus</i>	short-billed dowitcher	C	U	U	
<i>Limosa fedo</i>	a marbled godwit	R	R	O	
<i>Phalaropus lobatus</i>	red-necked phalarope	O	R	O	
<i>Phalaropus tricolor</i>	Wilson's phalarope	O	R	O	
<i>Scolopax minor</i>	American woodcock	U	U	U	
<i>Tringa flavipes</i>	lesser yellowlegs	U	O	U	

SHOREBIRDS: SANDPIPERS & ALLIES (cont'd)	Common Name	—Abundance—			
		Sp	Su	F	W
<i>Tringa melanoleuca</i>	greater yellowlegs	U	O	U	
<i>Tringa solitaria</i>	solitary sandpiper	U	U	U	
<b>TERNs (Laridae: Sterninae)</b>					
<i>Chlidonias niger</i>	black tern	O	O	O	
<i>Sterna caspia</i>	Caspian tern	C	O	C	
<i>Sterna forsteri</i>	Forster's tern	C	O	C	R
<i>Sterna hirundo</i>	common tern	C	O	C	R
<b>JAEGERS (Laridae: Stercorariinae)</b>					
<i>Stercorarius parasiticus</i>	parasitic jaeger			O	R
<b>GULLS (Laridae: Larinae)</b>					
<i>Larus argentatus</i>	herring gull	A	C	A	A
<i>Larus atricilla</i>	laughing gull	R	O	O	R
<i>Larus delawarensis</i>	ring-billed gull	A	A	A	A
<i>Larus fuscus</i>	lesser black-backed gull	O		U	O
<i>Larus glaucoides</i>	Iceland gull	O		O	U
<i>Larus hyperboreus</i>	glaucous gull	O		O	U
<i>Larus marinus</i>	great black-backed gull	U	O	U	C
<i>Larus minutus</i>	little gull	O	R	O	R
<i>Larus philadelphia</i>	Bonaparte's gull	C	O	A	O
<i>Larus pipixcan</i>	Franklin's gull	R	R	O	R
<i>Larus ridibundus</i>	black-headed gull	R		R	R
<i>Larus thayeri</i>	Thayer's gull	O		O	U
<i>Rissa tridactyla</i>	black-legged kittiwake	R		O	O
<b>DOVES (Columbidae)</b>					
<i>Columba livia</i>	rock dove	A	A	A	A
<i>Zenaida macroura</i>	mourning dove	A	A	A	A
<b>CUCKOOS (Cuculidae)</b>					
<i>Coccyzus americanus</i>	yellow-billed cuckoo	U	U	U	
<i>Coccyzus erythrophthalmus</i>	black-billed cuckoo	O	O	O	
<b>OWLS (Strigidae)</b>					
<i>Aegolius acadicus</i>	northern saw-whet owl	R	R	R	R
<i>Asio flammeus</i>	short-eared owl	R		O	O
<i>Asio otus</i>	long-eared owl	R		R	O
<i>Bubo virginianus</i>	great horned owl	C	C	C	C
<i>Nyctea scandiaca</i>	snowy owl	R		R	O
<i>Otus asio</i>	eastern screech-owl	C	C	C	C
<i>Strix varia</i>	barred owl	R	R	R	R
<b>BARN-OWLS (Tytonidae)</b>					
<i>Tyto alba</i>	barn-owl	R	R	R	R
<b>GOATSUCKERS &amp; ALLIES (Caprimulgidae)</b>					
<i>Caprimulgus vociferus</i>	whip-poor-will	O	R		
<i>Chordeiles minor</i>	common nighthawk	C	C	C	
<b>HUMMINGBIRDS (Trochilidae)</b>					
<i>Archilochus colubris</i>	ruby-throated hummingbird	C	C	C	
<b>SWIFTS (Apodidae)</b>					
<i>Chaetura pelagica</i>	chimney swift	C	C	C	
<b>KINGFISHERS (Alcedinidae)</b>					
<i>Ceryle alcyon</i>	belted kingfisher	C	C	C	U

	Common Name	—Abundance—			
		Sp	Su	F	W
<b>WOODPECKERS (Picidae)</b>					
<i>Colaptes auratus</i>	northern flicker	C	C	C	O
<i>Dryocopus pileatus</i>	pileated woodpecker	R	R	R	R
<i>Melanerpes carolinus</i>	red-bellied woodpecker	U	U	U	U
<i>Melanerpes erythrocephalus</i>	red-headed woodpecker	U	U	U	R
<i>Picoides pubescens</i>	downy woodpecker	C	C	C	C
<i>Picoides villosus</i>	hairy woodpecker	C	C	C	C
<i>Sphyrapicus varius</i>	yellow-bellied sapsucker	U	R	U	R
<b>PERCHING BIRDS</b>					
<b>TYRANT FLYCATCHERS (Tyrannidae: Fluvicolinae)</b>					
<i>Contopus cooperi</i>	olive-sided flycatcher	U	R	O	
<i>Contopus virens</i>	eastern wood-pewee	C	C	C	
<i>Empidonax alnorum</i>	alder flycatcher	O	R	O	
<i>Empidonax flaviventris</i>	yellow-bellied flycatcher	U	R	U	
<i>Empidonax minimus</i>	least flycatcher	C	U	U	
<i>Empidonax traillii</i>	willow flycatcher	C	C	O	
<i>Empidonax virescens</i>	Acadian flycatcher	C	C	U	
<i>Sayornis phoebe</i>	eastern phoebe	C	U	O	R
<b>KINGBIRDS (Tyrannidae: Tyranninae)</b>					
<i>Myiarchus crinitus</i>	great crested flycatcher	C	C	C	
<i>Tyrannus tyrannus</i>	eastern kingbird	C	C	C	
<b>LARKS (Alaudidae)</b>					
<i>Eremophila alpestris</i>	horned lark	C	C	C	C
<b>SWALLOWS (Hirundinidae)</b>					
<i>Petrochelidon pyrrhonota</i>	cliff swallow	O	R	O	
<i>Hirundo rustica</i>	barn swallow	C	C	C	
<i>Progne subis</i>	purple martin	C	C	C	
<i>Riparia riparia</i>	bank martin	O	O	O	
<i>Stelgidopteryx serripennis</i>	northern rough-winged swallow	C	C	C	
<i>Tachycineta bicolor</i>	tree swallow	C	C	C	R
<b>JAYS &amp; CROWS (Corvidae)</b>					
<i>Corvus brachyrhynchos</i>	American crow	C	C	C	C
<i>Cyanocitta cristata</i>	blue jay	A	A	A	A
<b>CHICKADEES (Paridae)</b>					
<i>Baeolophus bicolor</i>	tufted titmouse	C	C	C	C
<i>Poecile atricapillus</i>	black-capped chickadee	C	C	C	C
<b>NUTHATCHES (Sittidae)</b>					
<i>Sitta canadensis</i>	red-breasted nuthatch	U		U	U
<i>Sitta carolinensis</i>	white-breasted nuthatch	C	C	C	C
<b>CREEPERS (Certhiidae)</b>					
<i>Certhia americana</i>	brown creeper	U	R	U	O
<b>WRENS (Troglodytidae)</b>					
<i>Cistothorus palustris</i>	marsh wren	U	U	U	R
<i>Cistothorus platensis</i>	sedge wren	R	R	R	
<i>Thryothorus ludovicianus</i>	Carolina wren	O	O	O	O
<i>Troglodytes aedon</i>	house wren	C	C	C	
<i>Troglodytes troglodytes</i>	winter wren	C		O	O
<b>GNATCATCHERS (Sylviidae)</b>					
<i>Poliophtila caerulea</i>	blue-gray gnatcatcher	C	C	C	

	Common Name	Abundance			
		Sp	Su	F	W
<b>KINGLETS (Regulidae)</b>					
<i>Regulus calendula</i>	ruby-crowned kinglet	C		C	O
<i>Regulus satrapa</i>	golden-crowned kinglet	C		C	O
<b>THRUSHES (Turdidae)</b>					
<i>Catharus fuscescens</i>	veery	U	O	U	
<i>Catharus guttatus</i>	hermit thrush	U	R	U	R
<i>Catharus minimus</i>	gray-cheeked thrush	U		U	
<i>Catharus ustulatus</i>	Swainson's thrush	U	R	U	
<i>Hylocichla mustelina</i>	wood thrush	C	C	C	
<i>Sialia sialis</i>	eastern bluebird	U	U	U	O
<i>Turdus migratorius</i>	American robin	A	A	A	U
<b>MOCKINGBIRDS (Mimidae)</b>					
<i>Dumetella carolinensis</i>	gray catbird	C	C	C	
<i>Mimus polyglottos</i>	northern mockingbird	R	R	R	R
<i>Toxostoma rufum</i>	brown thrasher	U	U	U	R
<b>PIPITS (Motacillidae)</b>					
<i>Anthus spinoletta</i>	water pipit	U		U	
<b>WAXWINGS (Bombycillidae)</b>					
<i>Bombycilla cedrorum</i>	cedar waxwing	C	C	C	U
<b>SHRIKES (Laniidae)</b>					
<i>Lanius excubitor</i>	northern shrike	R		R	O
<i>Lanius ludovicianus</i>	loggerhead shrike	R	R	R	
<b>STARLINGS (Sturnidae)</b>					
<i>Sturnus vulgaris</i>	European starling	A	A	A	A
<b>VIREOS (Vireonidae)</b>					
<i>Vireo flavifrons</i>	yellow-throated vireo	U	U	U	
<i>Vireo gilvus</i>	warbling vireo	C	C	C	
<i>Vireo griseus</i>	white-eyed vireo	O	O	O	
<i>Vireo olivaceus</i>	red-eyed vireo	C	C	C	
<i>Vireo philadelphicus</i>	Philadelphia vireo	O		O	
<i>Vireo solitarius</i>	blue-headed vireo [=solitary vireo]	U	O	U	
<b>WOOD-WARBLERS (Parulidae)</b>					
<i>Dendroica caerulescens</i>	black-throated blue warbler	U		U	
<i>Dendroica castanea</i>	bay-breasted warbler	C		C	
<i>Dendroica cerulea</i>	cerulean warbler	U	U	U	
<i>Dendroica coronata</i>	yellow-rumped warbler	C		C	O
<i>Dendroica discolor</i>	prairie warbler	R	R	R	
<i>Dendroica dominica</i>	yellow-throated warbler	O			
<i>Dendroica fusca</i>	Blackburnian warbler	U		U	
<i>Dendroica magnolia</i>	magnolia warbler	U		U	
<i>Dendroica palmarum</i>	palm warbler	U		U	
<i>Dendroica pensylvanica</i>	chestnut-sided warbler	U	O	U	
<i>Dendroica petechia</i>	yellow warbler	C	C	C	
<i>Dendroica pinus</i>	pine warbler	O		U	
<i>Dendroica striata</i>	blackpoll warbler	O		C	
<i>Dendroica tigrina</i>	Cape May warbler	U		U	
<i>Dendroica virens</i>	black-throated green warbler	U		U	
<i>Geothlypis trichas</i>	common yellowthroat	C	C	C	R
<i>Icteria virens</i>	yellow-breasted chat	U	U	U	
<i>Mniotilta varia</i>	black-and-white warbler	U	R	U	
<i>Oporornis philadelphia</i>	mourning warbler	O		R	
<i>Parula americana</i>	northern parula	U	R	O	
<i>Protonotaria citrea</i>	prothonotary warbler	O	O	O	
<i>Seiurus aurocapillus</i>	ovenbird	U	U	U	

	Common Name	—Abundance—			
		Sp	Su	F	W
<b>WOOD-WARBLERS (cont'd)</b>					
<i>Seiurus motacilla</i>	Louisiana waterthrush	U	R	U	
<i>Seiurus noveboracensis</i>	northern waterthrush	U	R	U	
<i>Setophaga ruticilla</i>	American redstart	C	C	C	
<i>Vermivora celata</i>	orange-crowned warbler	O		O	R
<i>Vermivora chrysoptera</i>	golden-winged warbler	O	R	R	
<i>Vermivora peregrina</i>	Tennessee warbler	C		C	
<i>Vermivora pinus</i>	blue-winged warbler	U	U	U	
<i>Vermivora ruficapilla</i>	Nashville warbler	U		U	
<i>Wilsonia canadensis</i>	Canada warbler	U		U	
<i>Wilsonia citrina</i>	hooded warbler	U	O	U	
<i>Wilsonia pusill</i>	Wilson's warbler	U		U	
<b>TANAGERS (Thraupidae)</b>					
<i>Piranga olivacea</i>	scarlet tanager	U	U	U	
<b>CARDINALS (Cardinalidae)</b>					
<i>Cardinalis cardinalis</i>	northern cardinal	C	C	C	C
<i>Passerina cyanea</i>	indigo bunting	C	C	C	
<i>Pheucticus ludovicianus</i>	rose-breasted grosbeak	U	U	U	
<i>Spiza americana</i>	dickcissel	R	R	R	
<b>AMERICAN SPARROWS (Emberizidae)</b>					
<i>Ammodramus caudacutus</i>	saltmarsh sharp-tailed sparrow	R		O	
<i>Ammodramus henslowii</i>	Henslow's sparrow	R	R	R	
<i>Ammodramus savannarum</i>	grasshopper sparrow	O	U	O	
<i>Calcarius lapponicus</i>	Lapland longspur	O		O	O
<i>Junco hyemalis</i>	dark-eyed junco	C		C	C
<i>Melospiza georgiana</i>	swamp sparrow	U	O	U	O
<i>Melospiza lincolni</i>	Lincoln's sparrow	U		U	R
<i>Melospiza melodia</i>	song sparrow	C	C	C	C
<i>Passerculus sandwichensis</i>	Savannah sparrow	U	C	U	R
<i>Passerella iliaca</i>	fox sparrow	U		U	R
<i>Pipilo erythrophthalmus</i>	eastern towhee [=rufous-sided towhee]	C	C	C	R
<i>Plectrophenax nivalis</i>	snow bunting	O		C	U
<i>Pooecetes gramineus</i>	vesper sparrow	U	U	U	
<i>Spizella arborea</i>	American tree sparrow	C		U	C
<i>Spizella passerina</i>	chipping sparrow	U	C	U	
<i>Spizella pusilla</i>	field sparrow	C	C	C	R
<i>Zonotrichia albicollis</i>	white-throated sparrow	C	R	C	U
<i>Zonotrichia leucophrys</i>	white-crowned sparrow	U		U	O
<b>BLACKBIRDS &amp; ORIOLES (Icteridae)</b>					
<i>Agelaius phoeniceus</i>	red-winged blackbird	A	A	A	U
<i>Dolichonyx oryzivorus</i>	bobolink	U	C	U	
<i>Euphagus carolinus</i>	rusty blackbird	U		U	O
<i>Icterus galbula</i>	Baltimore oriole [=northern oriole]	C	C	C	
<i>Icterus spurius</i>	orchard oriole	U	U	O	
<i>Molothrus ater</i>	brown-headed cowbird	C	C	C	O
<i>Quiscalus quiscula</i>	common grackle	A	A	A	O
<i>Sturnella magna</i>	eastern meadowlark	C	C	C	O
<i>Sturnella neglecta</i>	western meadowlark	R	R	R	
<b>FINCHES &amp; ALLIES (Fringillidae)</b>					
<i>Carduelis flammea</i>	common redpoll	O		R	O
<i>Carduelis pinus</i>	pine siskin	O	R	U	O
<i>Carduelis tristis</i>	American goldfinch	C	C	C	C
<i>Carpodacus mexicanus</i>	house finch	A	A	A	
<i>Carpodacus purpureus</i>	purple finch	U	O	U	U
<i>Coccothraustes vespertinus</i>	evening grosbeak	O		O	O

**FINCHES & ALLIES (cont'd)***Loxia curvirostra**Loxia leucoptera**Pinicola enucleator***OLD WORLD SPARROWS (Passeridae)***Passer domesticus*

	Common Name	Abundance			
		Sp	Su	F	W
	red crossbill	R		R	R
	white-winged crossbill	R		R	R
	pine grosbeak	R		R	R
	house sparrow	A	A	A	A

**Seasonal Designations:**

Sp – Spring (March-May)

Su – Summer (June-August)

F – Fall (September-November)

W – Winter (December-February)

**Abundance Codes:**

A – Abundant

C – Common

O – Occasional

U – Uncommon

R – Rare

**APPENDIX F. AMPHIBIAN, REPTILIAN, AND MAMMALIAN FAUNA  
OF OLD WOMAN CREEK ESTUARY, WATERSHED,  
AND ADJACENT TRIBUTARIES AND WATERS OF LAKE ERIE**

**AMPHIBIANS**

	<b>Common Name</b>	<b>Location</b>
<b>NEWTS (Salamandridae)</b> <i>Notophthalmus viridescens</i>	eastern newt	TR
<b>MUDPUPPIES (Proteidae)</b> <i>Necturus maculosus</i>	mudpuppy	LE,TR
<b>MOLE SALAMANDERS (Ambystomatidae)</b> <i>Ambystoma jeffersonianum</i> <i>Ambystoma maculatum</i> <i>Ambystoma opacum</i> <i>Ambystoma platineum</i> <i>Ambystoma texanum</i> <i>Ambystoma tigrinum</i> <i>Ambystoma hybrid mole salamander</i>	Jefferson’s salamander spotted salamander marbled salamander silvery salamander small-mouthed salamander tiger salamander CK,ES,TR	TR CK,TR TR TR TR TR
<b>LUNGLESS SALAMANDERS (Plethodontidae)</b> <i>Desmognathus fuscus</i> <i>Eurycea bislineata</i> <i>Hemidactylium scutatum</i> <i>Plethodon cinereus</i> <i>Plethodon glutinosus</i> <i>Plethodon richmondi</i> <i>Pseudotriton ruber</i>	dusky salamander two-lined salamander 4-toed salamander eastern redback salamander slimy salamander ravine salamander red salamander	CK,TR CK,TR TR CK,ES,TR CK,ES,TR CK,ES,TR CK
<b>BUFONID TOADS (Bufonidae)</b> <i>Bufo americanus</i> <i>Bufo woodhousii fowleri</i>	American toad Fowler’s toad	CK,ES,TR ES,TR
<b>CRICKET FROGS AND TREEFROGS (Hylidae)</b> <i>Acris crepitans</i> <i>Hyla versicolor</i> <i>Pseudacris crucifer crucifer</i> <i>Pseudacris triseriata</i>	northern cricket frog gray treefrog northern spring peeper western chorus frog	TR TR CK,ES,TR ES,TR
<b>RANID FROGS (Ranidae)</b> <i>Rana catesbeiana</i> <i>Rana clamitans melanota</i> <i>Rana palustris</i> <i>Rana pipiens</i> <i>Rana sylvatica</i>	bullfrog green frog pickerel frog northern leopard frog wood frog	CK,ES,TR CK,ES,TR TR ES,TR TR

**REPTILES**

<b>MUD AND MUSK TURTLES (Kinosternidae)</b> <i>Sternotherus odoratus</i>	common musk turtle	TR
<b>SNAPPING TURTLES (Chelydridae)</b> <i>Chelydra serpentina</i>	snapping turtle	ES,TR
<b>BOX AND WATER TURTLES (Emydidae)</b> <i>Chrysems picta marginata</i> <i>Clemmys guttata</i> <i>Emydoidea blandingii</i> <i>Graptemys geographica</i> <i>Terrapene carolina carolina</i>	midland painted turtle spotted turtle Blanding’s turtle common map turtle eastern box turtle	CK,ES,TR ES,TR ES,TR ES,TR CK,ES,TR

**SOFTSHELL TURTLES (Trionychidae)**

*Apalone spiniferus*

**Common Name**  
spiny softshell turtle

**Location**  
ES,TR

**COLUBRID SNAKES (Colubridae)**

*Clonophis kirtlandii*  
*Coluber constrictor foxii*  
*Diadophis punctatus edwardsii*  
*Elapha obsoleta obsoleta*  
*Elapha vulpina gloydi*  
*Heterodon platyrhinos*  
*Lampropeltis triangulum triangulum*  
*Nerodia sipedon sipedon*  
*Opheodrys vernalis*  
*Regina septemvittata*  
*Storeria dekayi dekayi*  
*Storeria dekayi wrightorum*  
*Thamnophis butleri*  
*Thamnophis sauritus*  
*Thamnophis sirtalis sirtalis*  
*Thamnophis sirtalis sirtalis*

Kirtland's snake  
blue racer  
northern ring-neck snake  
black rat snake  
eastern fox snake  
eastern hog-nosed snake  
eastern milk snake  
northern water snake  
smooth green snake  
queen snake  
northern brown snake  
midland brown snake  
Butler's garter snake  
eastern ribbon snake  
eastern garter snake  
e. garter snake (melanistic)

TR  
CK,TR  
CK,TR  
CK,TR  
ES,TR  
TR  
ES,TR  
CK,ES,TR  
TR  
CK,TR  
ES,TR  
ES,TR  
ES,TR  
TR  
CK,ES,TR  
ES,TR

**VIPERS (Viperidae)**

*Sistrurus catenatus*

Massasauga rattlesnake

TR

**MAMMALS**

**OPOSSUMS (Didelphidae)**

*Didelphis virginiana*

Virginia opossum

CK,ES,TR

**SHREWS (Soricidae)**

*Blarina brevicauda*  
*Cryptotis parva*  
*Sorex cinereus*  
*Sorex hoyi* pygmy shrew

northern short-tailed shrew  
least shrew  
masked shrew  
ES,TR

ES,TR  
TR  
ES,TR

**MOLES (Talpidae)**

*Parascalops breweri*  
*Scalopus aquaticus*

hairy-tailed mole  
eastern mole

ES,TR  
CK,ES,TR

**VESPERTILIONID BATS (Vespertilionidae)**

*Eptesicus fuscus*  
*Lsionycteris noctivagans*  
*Lasiurus borealis*  
*Lasiurus cinereus*  
*Myotis keenii*  
*Myotis leibii*  
*Myotis lucifugus*  
*Pipistrellus subflavus*

big brown bat  
silver-haired bat  
red bat  
hoary bat  
Keen's myotis or Keen's bat  
small-footed myotis  
little brown bat  
e. pipistrelle or Georgian bat

TR  
TR  
TR  
TR  
TR  
TR  
ES,TR  
TR

**WOLVES & FOXES (Canidae)**

*Canis latrans*  
*Urocyon cinereoargenteus*  
*Vulpes vulpes*

coyote or brush wolf  
gray fox  
red fox

ES,TR  
ES,TR  
ES,TR

**PROCYONIDS (Procyonidae)**

*Procyon lotor*

raccoon

CK,ES,TR

**MUSTELIDS (Mustelidae)**

*Mustela frenata*  
*Mustela nivalis*  
*Mustela vison*  
*Taxidea taxus*  
*Mephitis mephitis*

long-tailed weasel  
least weasel  
mink  
badger  
striped skunk

ES,TR  
TR  
TR  
TR  
ES,TR



	Common Name	Location
<b>HARES &amp; RABBITS (Leporidae)</b> <i>Sylvilagus floridanus</i>	eastern cottontail rabbit	CK,ES,TR
<b>SQUIRRELS (Sciuridae)</b> <i>Glaucomys volans</i>	southern flying squirrel	TR
<i>Marmota monax</i>	woodchuck or groundhog	CK,ES,TR
<i>Sciurus carolinensis</i>	gray squirrel	TR
<i>Sciurus niger</i>	fox squirrel	CK,ES,TR
<i>Tamias striatus</i>	eastern chipmunk	CK,ES,TR
<i>Tamiasciurus hudsonicus</i>	red squirrel	CK,ES,TR
<b>BEAVERS (Castoridae)</b> <i>Castor canadensis</i>	beaver	ES
<b>RATS, MICE &amp; VOLES (Muridae)</b> <i>Peromyscus leucopus</i>	white-footed mouse	ES,TR
<i>Peromyscus maniculatus</i>	deer mouse	ES,TR
<i>Microtus pennsylvanicus</i>	meadow vole or field mouse	ES,TR
<i>Ondatra zibethicus</i>	muskrat	ES,TR
<i>Synaptomys cooperi</i>	southern bog lemming	TR
<i>Mus musculus</i>	house mouse	ES,TR
<i>Rattus norvegicus</i>	Norway rat or common rat	TR
<b>JUMPING MICE (Dipodidae)</b> <i>Zapus hudsonius</i>	meadow jumping mouse	ES,TR
<b>DEER (Cervidae)</b> <i>Odocoileus virginianus</i>	white-tailed deer	CK,ES,TR
<b>BOVIDS (Bovidae)</b> <i>Bison bison</i>	bison	CK

Location Codes:

- CK – Old Woman Creek watershed upstream of the estuary
- ES – Old Woman Creek estuary and contiguous uplands within State Nature Preserve
- LE – Lake Erie, principally nearshore waters of eastern Erie County and western Lorain County, Ohio
- TR – Tributary watersheds to Lake Erie other than Old Woman Creek, principally of eastern Erie County and western Lorain County, Ohio

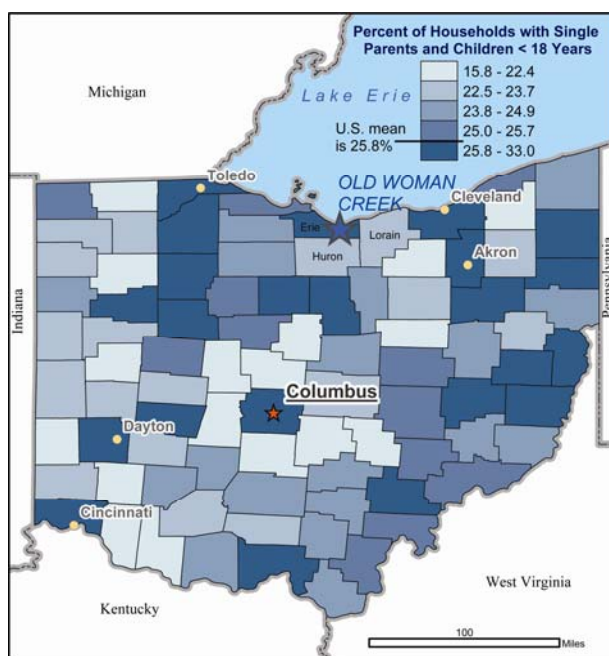
**Old Woman Creek NERR  
Management Plan**

**APPENDIX I**

**Social Assessment of the OWC NERR  
(Prepared for NOAA CSC)**

# Old Woman Creek, OH National Estuarine Research Reserve

## Community Characterization



Prepared by Shawn E. Dalton, Ph.D.  
for NOAA Coastal Services Center

Training Workshop  
Social Assessment: Tools and Techniques  
for Coastal Managers  
August 24-26, 2005  
Huron, Ohio



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## A. Introduction

The Old Woman Creek National Estuarine Research Reserve is a one-square-mile site located at the mouth of Old Woman Creek in Huron, Ohio. This site was selected as a case study for this social assessment training program because it falls along a trajectory from small, rural area to densely populated urban area; because the managers and staff of the Reserve expressed a strong interest in social assessment as a tool to inform their activities; and because its situation on a fresh water system distinguishes it from other National Estuarine Research Reserve (NERR) System sites.

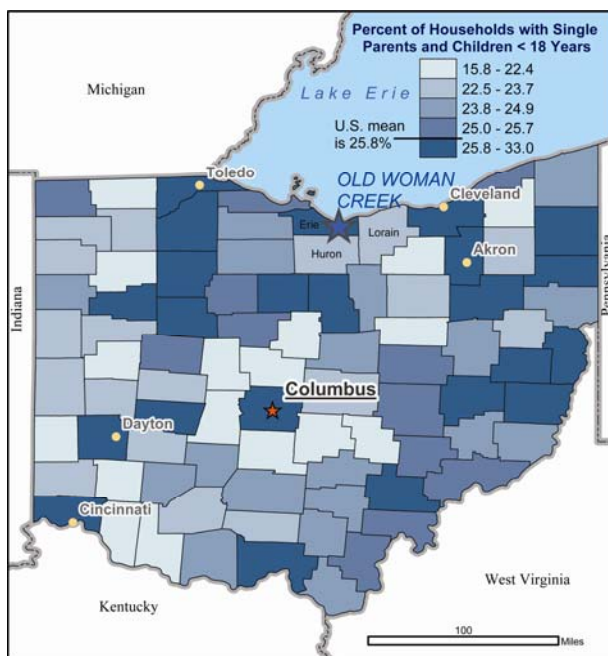


Figure 1. Location of Old Woman Creek NERR site

## B. Site Description and Needs Assessment

From September 20-22, 2004, a site visit was conducted by two social scientists. During this time, meetings were held with representatives of the Old Woman Creek National Estuarine Research Reserve and some of their partner organizations, both on and off-site. Informal, semi-structured interviews were conducted with three senior citizens of nearby Berlin Heights. During a tour of the area around the NERR site, several local residents were also informally interviewed. Finally, the two social scientists were invited to attend a meeting of the Berlin Heights Historical Society during the evening of September 21, 2005. According to representatives of

this long-standing organization, the Historical Society can and regularly does reach most families in the watershed through its membership mailings.

Combined, the site visit, tour, meetings, semi-structured interviews, and participation in the meeting of a local group, provided a broad overview of the site, its location relative to other natural and human features in the system, and a sense of the organizational and managerial issues faced by the Reserve managers and staff.

The primary issues identified are common to many rural watersheds in North America: farming and the way of life it has supported for generations is in transition. Many farms are for sale, as elder owners are no longer able to manage them, and their children do not live on the farm or espouse this way of life. Thus, land is available for consolidation into agribusiness enterprises, or for development.

In the 27-square-mile region that comprises the Old Woman Creek watershed, most of the land is designated agricultural land. There are approximately 1100 people who live in this watershed, both spread across the countryside and consolidated in several small towns. These include Berlin Heights, and portions of Milan and Huron. Interviewers were surprised to find that most people they spoke with not only knew of the Reserve and of Old Woman Creek, but have strong emotional and historical ties to this watercourse and its estuary. In the past, the land at the mouth of Old Woman Creek was cultivated and harvested. Adult residents, both junior and senior, spoke fondly of playing in the creek and the woods surrounding it as children. When asked whether the area had changed much in recent times, most respondents indicated that they have not witnessed much change. However it is likely that this represents their local perspective, as Reserve managers and representatives of State agencies indicated that the landscape is in transition. Agricultural lands are giving way to retirement communities as well as developments from which people commute to Cleveland and elsewhere to work. In addition, water monitoring over time indicates that there are elevated *E. Coli* counts in the system on an ongoing basis. This has potential deleterious effects on flora, fauna, and human health.

Regionally, there are a number of issues and trends that may affect Old Woman Creek and the estuary into which it drains. In particular, the region has a heavy influx of tourists during the summer season. This can be a



benefit or burden, depending upon how it is managed. The Reserve itself hosts a number of tourist visits during the summer, which provides an opportunity to fulfill its mission of education, potentially at a national scale. However, as tourism extends beyond the Cedar Point recreational area to the west, there is also the possibility of additional shoreline development, with the potential to negatively impact the estuarine environment at Old Woman Creek and beyond.

As a result of these initial discussions, and the apparent disconnect between opinions and observations of Reserve managers and local community representatives, a number of social assessment tools were selected for analysis of the Old Woman Creek site and the communities in which it is situated. The reserve could potentially benefit from a variety of socioeconomic analyses. These include:

1. A general community characterization of the area that will allow for comparative analysis of local, regional, state, and national trends in socioeconomic variables;
2. Formal focus groups with representatives of local agencies and communities to articulate more clearly whether and how they interact with the Old Woman Creek Reserve site, whether and how they consider the landscape to be in transition, and what they consider to be potential threats and means by which they might be addressed in the area;
3. Coupled with the focus groups, a mapping exercise to identify people's "home ranges" as they relate to work, leisure, consumption, and social activities. This information can be used to evaluate people's perspectives of changing landscape patterns;
4. An environmental history of the watershed and its communities;
5. An economic analysis of the communities in the watershed and region.

This document does not address all of these socioeconomic analyses. It does, however, explain why the community characterization was undertaken at 3 levels of geography. There was a clear disconnect between people's perceptions of local trends and observations on the landscape. There is, indeed, a great deal of both residential and

commercial development taking place in the area near the Old Woman Creek Reserve. It was clear that definitions of “local” varied tremendously, depending upon whose opinion was being solicited. It was also clear that it was necessary to examine these trends at different scales; hence, the levels of analysis selected for the community characterization.

### C. Community Characterization

Here, we characterize, at a broad scale, socioeconomic conditions of communities around the Old Woman Creek NERR. Information for these summaries was derived primarily from the 2000 decennial census, which was downloaded and displayed on a series of maps. The maps are included in this community characterization; each sheet includes text interpreting the findings at different scales for the variable it depicts, including state/county, and region/locale around the Reserve.

The maps present data on a subset of variables in the human ecosystem framework (Machlis et al. 1997): under Biophysical Resources, *energy*; under Socioeconomic Resources, *population, labor, and capital*; under Social Cycles, *institutional cycles*; under Social Order, *age, class, power, wealth*. Figure 2, below, shows the indicators selected for each of these variables, as well as the map sheet on which they are represented. Here, synthesis is intended to detect and present relationships among the variables shown on the maps.

Below, the findings in these maps are summarized by variable. The relationships among these variables are then discussed to provide a synthesis of findings. We conclude with suggestions for additional social assessments that might be of use to the managers of this reserve.

Figure 2.

<b>Variable</b>	<b>Indicator and/or Measure</b>	<b>Sheet Number</b>
Population	Number of persons per census geography	One
Population	Number of people per square mile	Two
Population	Percent change in total resident population between 1990 and 2000	Three
Age	Median age of total population	Four
Capital	Median household income	Five
Class	Percent skilled and professional workers	Six
Power	Percent of households with income over \$100,000	Seven
Wealth	Percent persons living below poverty line	Eight
Institutional Cycles	Ratio of population <18 to >64 years of age	Nine
Energy	Time traveled to work	Ten
Informal Norms	Percent of households with own children under 18 years living at home, headed by a single parent (male or female)	Eleven

### C-1. Population

Population includes both the number of individuals and the number of social groups and cohorts within a social system. It is an important socioeconomic resource as it determines the consumption impacts of people as well as their creative actions. Because development is an important issue at most NERR sites, three indicators of population were measured and mapped for the community characterizations: absolute population, population density, and county-level change in population between 1990 and 2000.

Ohio is among the most populous states in the US. Three counties in the region of the Old Woman Creek Reserve, Erie, Huron, and Lorain, are home to between 75,000 and 150,000 people. While there is a concentration of population in the census blocks along Lake Erie in the OWC region, the blocks immediately adjacent to and containing the reserve are among the least populated in the region.

Likewise, population density is very low in the census blocks adjacent to the Reserve, with a maximum density of 184 people/square mile. This increases quite dramatically to the east of the Reserve in the Cleveland area, where population densities approach 5000 people/square mile; and to the west in Sandusky where densities of 1250-2999 people/square mile are common. Between 1990 and 2000, the counties in the immediate environs of the OWC Reserve increased in population by up to 3.5%, while the

county in which densely populated Cleveland is located actually lost up to 8.0% of its population. It is not possible to compare these trends at the regional and locale (i.e. the census areas comprising the Reserve and its watershed) scales, as the 1990 data were not readily available along the same higher resolution census geographies as the 2000 data.

## C-2. Age

Age is an important component of social structure for several reasons. Most of human activity is age-dependent. Mining, for example, is an occupation primarily carried out by the young. Certain recreational activities, such as golf, are often associated with the elderly. Age distribution within a community is also an important determinant of social institutions such as education and health care. Likewise, age can be an important factor in political activity and proclivity.

The median age of the people in Ohio is 37.5 years, substantially higher than the national median of 35.5. This means that half the people in the state are older than 37.5 and half are younger. The counties around the Old Woman Creek Reserve display variation in median age, from well above the national average (up to 48.6 years in some cases) to well below it (between 25.7 and 35.5). At the higher resolution census geography, this pattern is more subtle, with an obvious decreasing median age in the census blocks to the south (and upstream) of the watershed in which the Reserve is located. The census blocks along the shores of Lake Erie and just inland from it are among those with the highest median age in the area, clustering between 48 and 58 years old. Thus, there is a high concentration of people at or approaching retirement age in the immediate vicinity of the Reserve.

## C-3. Capital

In the human ecosystem framework, capital is defined as the economic instruments of production; that is, financial resources (money or credit supply), resource values (such as underground oil), and the human ability to manipulate these (human capital). Capital can be measured in a variety of ways; for our purposes, median household income is used to measure capital.

In Ohio, there is a strong east-west pattern of southernmost counties with a median household income well below the national median (approximately

\$42,000/year) and the state median (\$38,726). In the counties surrounding the Old Woman Creek Reserve and its watershed, median household incomes are near or above the state median. Most of the census block groups near the Reserve exhibit median household incomes well above the state median. There are some exceptions to this, in particular in Sandusky where many block groups have median household incomes of between \$4,732 and \$24,999.

#### C-4. Class

The term, class, is used in various ways in sociology. It usually implies a group of individuals sharing a common situation within a social structure, usually their shared place in the structure of ownership and control of the means of production (Dictionary of Social Science, <http://bitbucket.icaap.org/dict.pl>).

Class is represented in this work as the percent of the work force who are employed in skilled or professional occupations. These include doctors, lawyers, professors, computer specialists, and so on. In Ohio, there is a wide range of levels of skilled and professional workers, with counties containing centers of population and those along the shores of Lake Erie exhibiting higher concentrations than others. Near Old Woman Creek NERR, the pattern is equally variable, ranging from 0.0-9.0% to up to 25-73.0%. Immediately to the west of the Reserve, the rates are quite high, in fact higher than the national average. However, the census block groups containing and south of the Reserve and its watershed range from 0.0-19.9%.

#### C-5. Power

Power is the ability to alter others' behaviour, either by coercion or deference (Wrong, 1988; Mann, 1984). The powerful, often elites with political or economic power, or both, can have access to resources denied the powerless. Here, we measure power in terms of income, with those having a household income of \$100,000 or more considered to be more powerful than those with lower incomes.

In Ohio, the concentration of households with this income level ranges from 2.2%-27.5%, with power being concentrated in centers of population. In the area to the west of the Old Woman Creek Reserve, however, there is a

high concentration of powerful block groups. Within the Old Woman Creek watershed, block groups at this income level range from 0.0%-18.9%.

#### C-6. Wealth

Wealth is access to material resources, in the form of natural resources, capital (money) and credit. The distribution of wealth is a central feature of social inequality and has human ecosystem implications: the rich have more life opportunities than the poor. Here, we measure the inverse of wealth by examining poverty rates in the areas around the research reserve sites. The poverty line in the United States is defined as an annual income of \$18,660 or less for a family of four.

In Ohio, there are many high poverty counties in the southwestern part of the state. Around the Old Woman Creek NERR, counties have relatively low poverty rates. However, the block groups around the Reserve display the full range of poverty rates, from 0-18% and above. There is a slight trend of relatively low to relatively high rates of poverty moving inland from the shores of Lake Erie and the vicinity of the OWC Reserve. The block group containing the OWC reserve itself is among those with the highest poverty rates on the coast of Lake Erie.

#### C-7. Institutional Cycles

Time is both a fixed resource and a key organizing tool for human behavior. Some cycles may be physiological (such as diurnal patterns); others institutional (permitted hunting seasons). Social cycles, such as the set of collective rhythms within a community or culture that organize its calendar, festivals, harvests, fishing seasons, business days, and so forth, significantly influence the distribution of critical resources.

Institutional cycles are critical to human ecosystem functioning, for they provide guidance and predictability to the ebb and flow of human action. Here, we measure institutional cycles in terms of age distribution, since the relative proportion of children to elderly will influence the need for, flow and use of different resources in a community.

In Ohio, counties with the highest ratios of children to elderly are those containing centers of population. The counties containing Cleveland and Akron are exceptions; however, the counties immediately adjacent to them show high ratios of children to elderly. In the area of the OWC Reserve,

the ratios of children to elderly range from 1 to 10, with the highest ratio southwest of the Reserve in the area of Milan. Immediately west of the Reserve, and further west along the coast of Lake Erie, the block groups are among those with the lowest ratios of children to elderly. Given the median age in these areas, this is not surprising.

## C-8. Energy

Energy is the ability to do work or create heat. Energy is a critical natural resource and is tremendously influential on social systems. The energy available to humans “limits what we can do, and influences what we will do” (Cottrell, 1955). Here, we have used commuting time as a proxy measure for energy consumption. Analysis of commuting data from the US census indicated that a majority of the 128.3 million commuters in the United States travel alone by car, and travel for between 15 and 45 minutes to get to work. The percentage of commuters traveling 15-45 minutes by census geography was measured to give a sense of relative energy consumption patterns.

In Ohio, in the densely populated counties spanning the southwestern and northeastern regions of the state, 54.9-64.7% of commuters spend between 15 and 45 minutes driving to work and back. In the region around Old Woman Creek, even higher proportions of commuters spend this much time traveling: 60.5%-77.3% in the census tracts containing and to the east of the watershed. Relatively few people work at home in the watershed (<2%) or region (no more than 13.2%). This supports the observation made by Reserve managers that a relatively small proportion of the population in the area remains engaged in farming.

## C-9. Informal Norms

Informal norms are the unwritten, and sometimes unspoken, rules that govern human behaviour. Informal norms are delivered to children as they are socialized; as we age, we continue to acquire expertise regarding structure and function of our social interactions. We are often unaware of informal norms until they have been violated. Here, we measure informal norms by determining the rate of single-parent households. Most single-parent households are, in fact, single-mother households: “Of all custodial parents, 85% were mothers and 15% were fathers” in 2000 (<http://www.parentswithoutpartners.org/Support1.htm>). Informal norms

around family structure and composition are changing in North American families.

In Ohio, the rates of single-parent households by county range from 15.8% to 33.0%. North central and southwestern counties exhibit higher rates than others. In the region around the OWC NERR, both to the east and west, there are relatively high rates of single-parent households, up to 64.5%. However, in the census block groups containing the Reserve and its watershed, the rates are among the lowest in the state, ranging from 11.3% to 17.5%.

#### D. Summary of Findings

The communities in the region in the vicinity of Old Woman Creek National Estuarine Research Reserve display a variety of characteristics, particularly when compared across geographic scales. At the locale or watershed scale, the population density is fairly low, with a southern/inland trend from older, affluent, more highly educated, and powerful residents to areas with higher proportions of children to elderly, and lower median incomes. Overall, the watershed displays quite low incidences of single-parent households. A large majority of commuters in the region travel quite far to work, indicating that this area may be increasingly, as indicated during semi-structured interviews with residents, a residential community to places such as Cleveland or Sandusky.

In the regions east and west of the Reserve, there are clusters of densely populated and low-income regions, with fairly strong indications of uneven distributions of affluence, poverty, and power. In addition, there are high numbers of single-parent households, both east and west of the Reserve.

The data indicate that the region comprising the Old Woman Creek Watershed is in flux. The watershed itself comprises strong communities and families, a sense of place, and a rural and small-town character. Along the shores of Lake Erie, however, the population is older and comprised of fewer families with children under 18 at home. Further afield, there are higher concentrations of poverty, denser populations, and according to interviewees, seasonal economic activity – particularly in the area around Sandusky.

The general impression, then, is one of a pocket of rural and small-town lifestyle, which is at risk of encroachment from changing economics and



demographics. To the east, Cleveland appears to be extending its reach into the watershed as commuting from the area becomes and increasingly viable and attractive option. To the west, seasonal Sandusky may be less influential. And along the shores of Lake Erie, retirees and soon-to-be retirees seem to be settling.

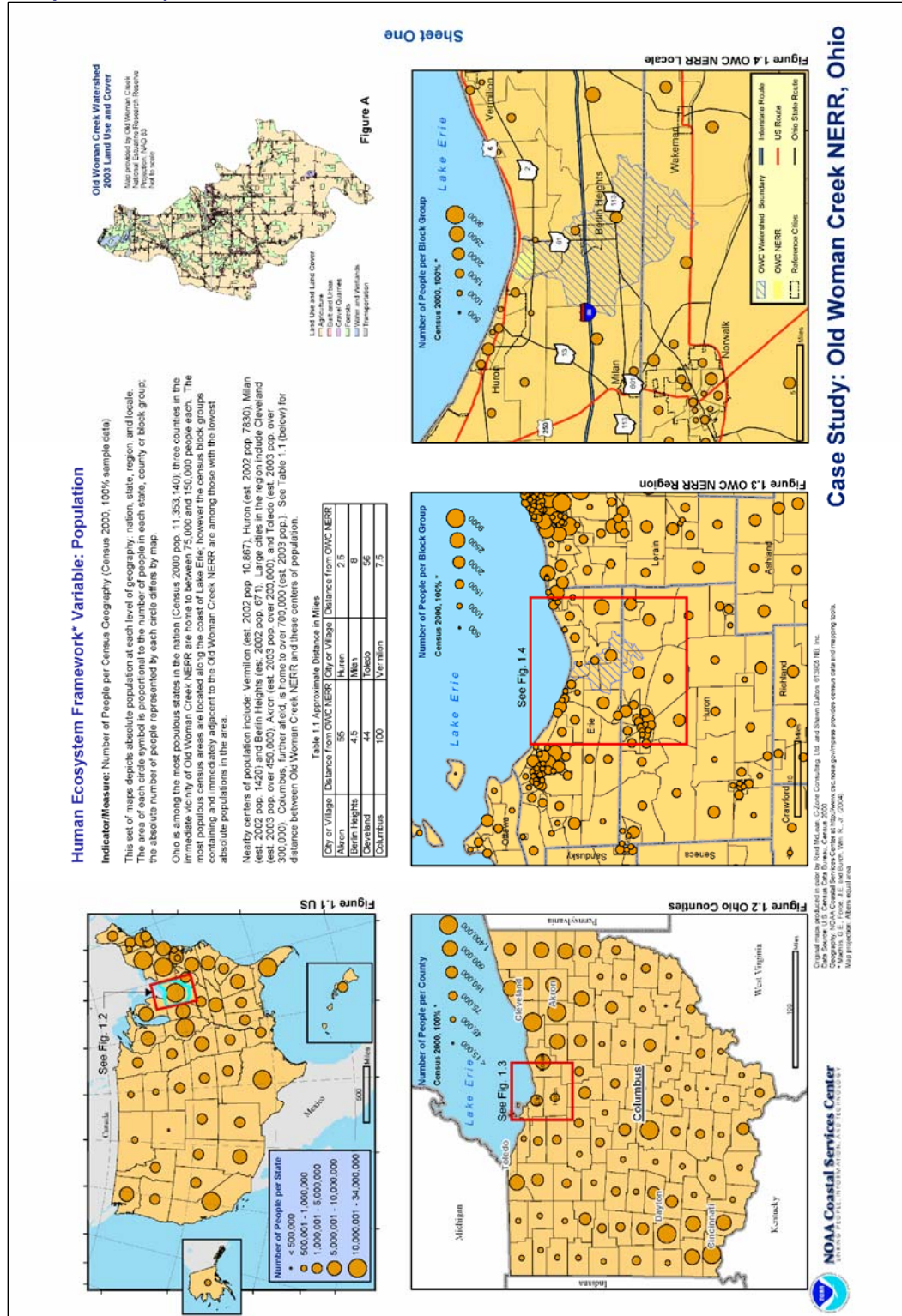
#### E. Recommended Future Directions for Related Activities at the Old Woman Creek, OH National Estuarine Research Reserve

There are a number of potential opportunities that present themselves, based on these findings, the results of interviews, and focus groups.

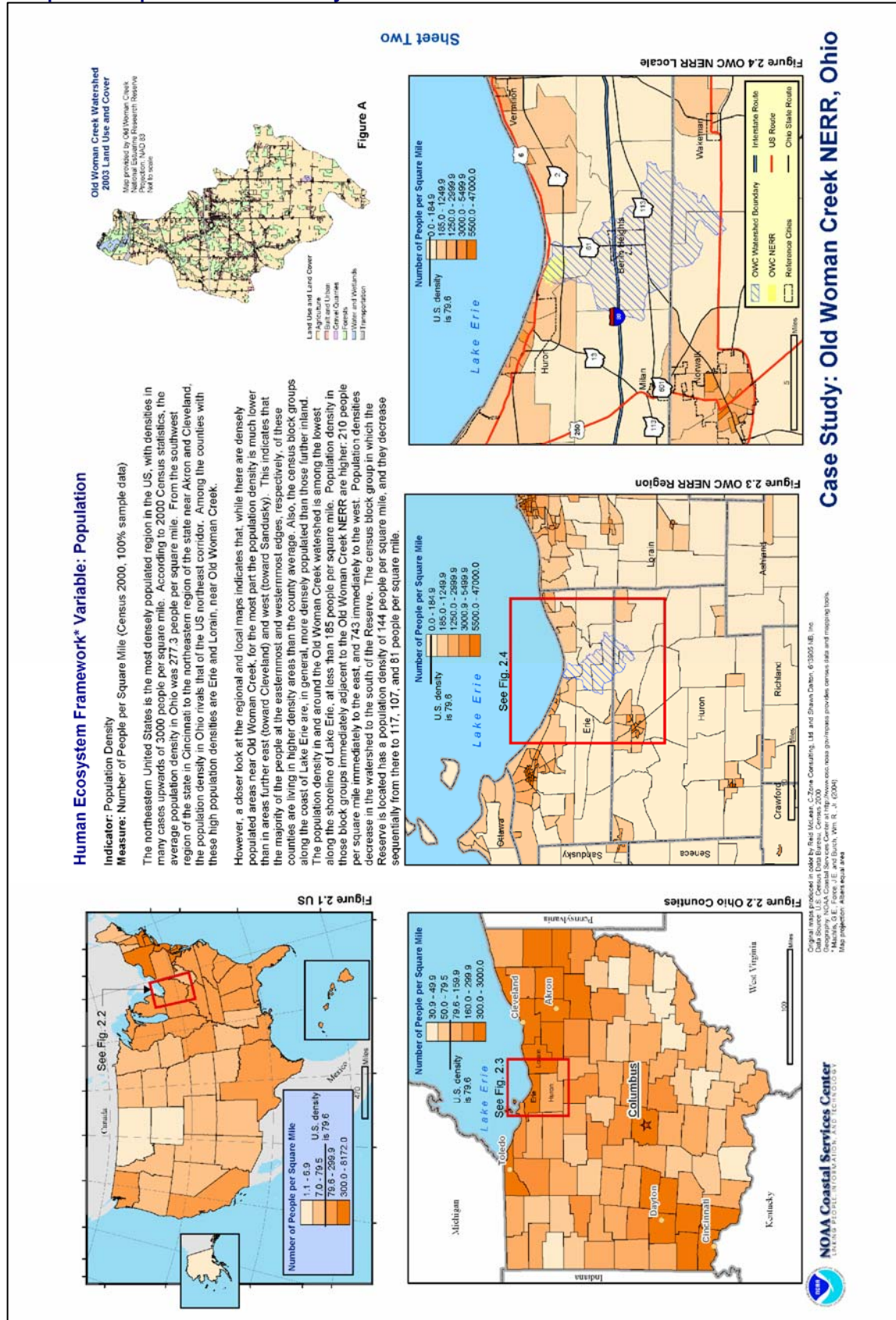
- 1) Identify a local champion, from the community, to start a Watershed Association of some sort. This can range from a small, informal group, to a fully incorporated 501(c)(3) non-profit organization. A number of landscape-level management issues identified by Old Woman Creek NERR representatives would be most effectively addressed by local people using local strategies, and their internal networks. The strength of the cohesive, small-town nature of the communities in the watershed should be investigated in more detail, and harnessed.
- 2) Engage the resources of the residents along the shoreline of Lake Erie. These are likely to be older, well-educated, and fairly affluent people. Targeting them to build up the volunteer core of the NERR makes sense, not only in terms of bringing resources into the Reserve, but also in terms of educating those with shoreline property about their land management strategies.
- 3) In order to develop effective and targeted communication tools, conduct more detailed community studies. Clearly, the region in the area around the Old Woman Creek Reserve comprises more than one “community.” This means that different communication and outreach tools will work differentially in different parts of the region. More detailed studies would be required to work out how these strategies, if desired, would be most effectively delivered.
- 4) The high ratio of children to elderly people in the upper reaches of the watershed indicates that working with schools may be a particularly potent means of assisting land owners to protect riparian habitat and encourage other forms of landscape stewardship practices in that area.

# F. Maps of Socioeconomic Characteristics: Old Woman Creek National Estuarine Research Reserve

## Map 1: Population



# Map 2: Population Density



# Map 3: Population Change

## Human Ecosystem Framework Variable: Population

**Indicator:** Population Change

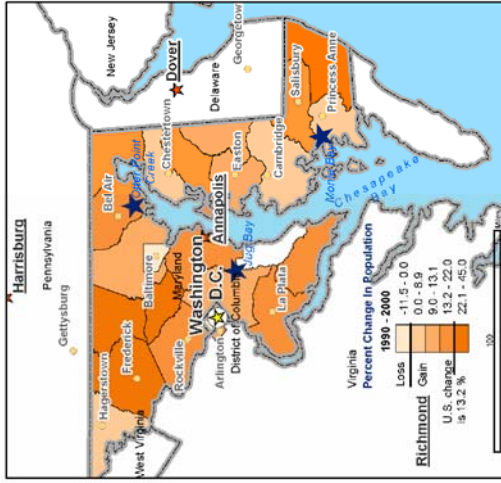
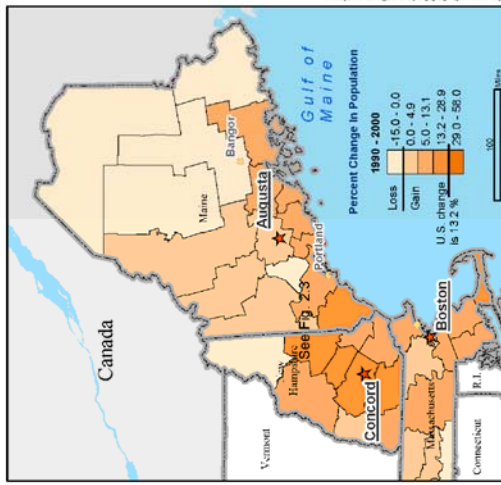
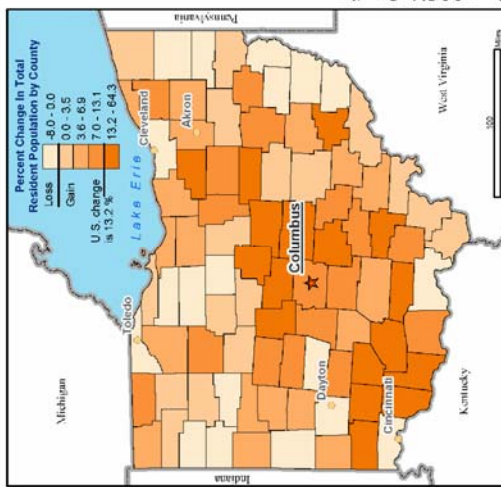
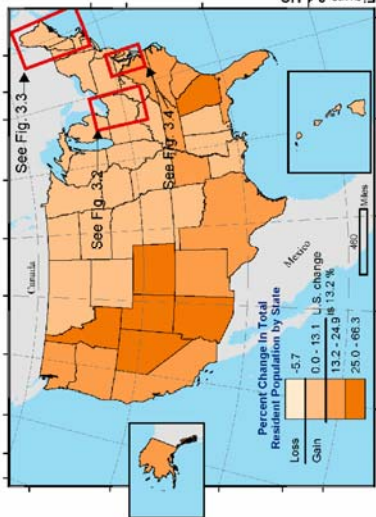
**Measure:** Percent Change in Total Resident Population by Census Geography, between 1990 and 2000 (Census 1990, Census 2000, 100% sample data)

Change in population at the national level, by state, varies from a net loss of population of 5.7% (District of Columbia) to an increase of as much as 66.3% (Nevada). All states with the exception of the District of Columbia experienced a net increase in population, although in some cases this increase was marginal. The national average is an increase of 13.2%. There is an obvious pattern of higher rates of population increase in the southern and western states, ranging from 13.2% - 66.3%. The northern and central states grew in population less dramatically, between 0.0% and 13.1%.

The population of Ohio grew by 4.7%, Kentucky by 9.7%, Michigan by 6.9%, and West Virginia by 0.8%. In Ohio, counties in the southern and central regions of the state increased in population by between 7.0 and 64.3%. In the counties around the Old Woman Creek NERR site, however, the population actually decreased by 1.5% (Cuyahoga), or grew very little - 3.6% in Erie County, 5.9% in Huron County, and 5.0% in Lorain County.

In Maine, while overall the state experienced an increase in population of 3.8%, there is an obvious decrease in population in the northernmost counties - up to 15% in some cases. The coastal and southern counties in Maine increased in population between 1990 and 2000 by as much as 56.0%. The counties in the vicinity of the Wells NERR are among those with the highest growth rates. The population of York County, where the Wells NERR is located, grew by 13.5%. The population of neighboring Massachusetts increased by 5.8% overall, while New Hampshire grew by 11.4%.

Maryland's population increased by 10.8%; Virginia's by 14.4%, Delaware's by 17.8%, and Pennsylvania's by 3.4%. The increase in population in Maryland, by county, ranged from 0.0% - 45%, with the county where the Jug Bay NERR site is located, Calvert, having the highest growth rate in the state. The populations of nearby Prince George's County grew by 9.9% and Anne Arundel by 14.6%. Baltimore City, near the Otter Point NERR site, lost 11.5% of its population, while surrounding Baltimore County gained 8.9%. Harford County, where the Otter Point Creek site is located, gained 20.0%. The counties in the vicinity of the Monticello Bay NERR site experienced a much broader range in population growth: 5.6% (Somerset); 1.2% (Dorchester); 13.9% (Wicomico); 32.9% (Worcester).



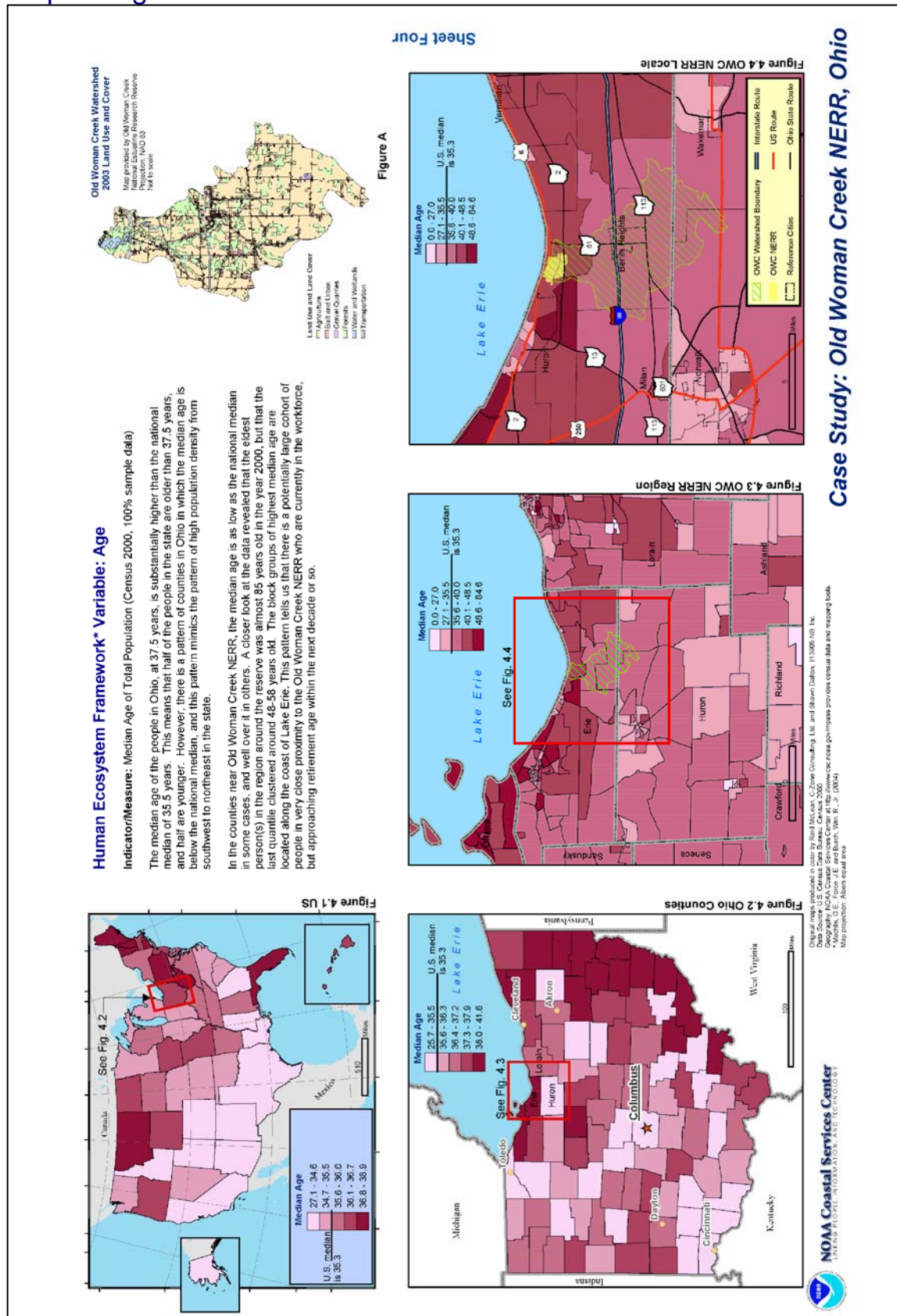
Sheet Three

**Case Study: National Estuarine Research Reserve**

Original maps produced in color by Reed Muesel, CZone Consulting, Ltd. and Sherril Dalton, ©1995 RE, Inc. Digitized by NOAA Coastal Services Center at [http://www.csc.noaa.gov/marine\\_products/census\\_data\\_and\\_mapping\\_tools](http://www.csc.noaa.gov/marine_products/census_data_and_mapping_tools). Map prepared: Anna Rappaport, W. R. J. (2004)

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Map 4: Age



# Map 5: Capital

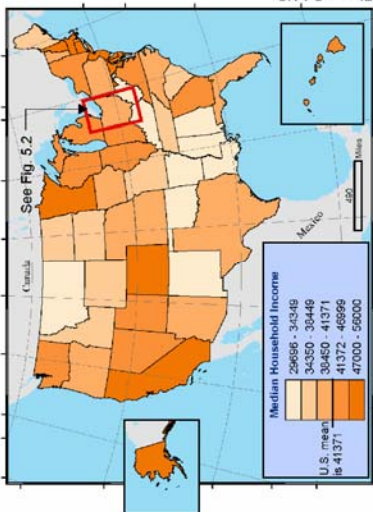


Figure 5.1 US

## Human Ecosystem Framework\* Variable: Capital

**Indicator/Measure:** Median Household Income (Census 2000, 100% sample data)

The median household income in the United States is just over \$41,000. This means that half the households in the country earn more than this amount and half less. In many states in the northeastern and southwestern US, the median household income is substantially higher than the national median. In many southern states, the opposite is true.

In Ohio, there is a strong east-west pattern of southern most counties with a median household income well below the national median, and below the state median of \$38,726 (Census 2000). By contrast, no equally obvious pattern of counties above the state median is discernible, although certainly the median household income in many counties is above the state and national medians.

In the counties surrounding Old Woman NERR and its watershed the median household incomes are near or above the state median. The same is true of the census block groups near the Reserve, with the exception of the one which the Reserve is located, where the median household income ranges between \$4,732 and \$27,969.

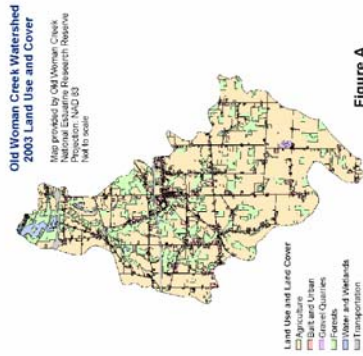


Figure A

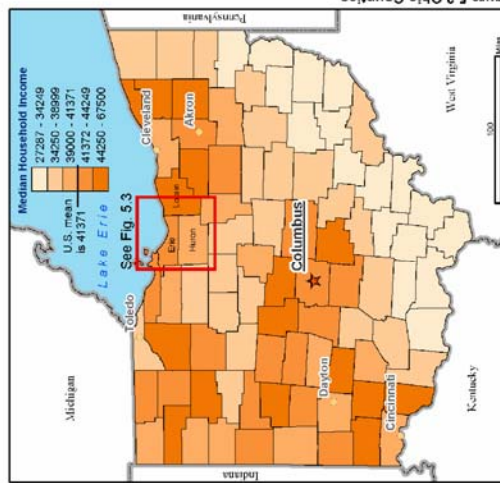


Figure 5.2 Ohio Counties



Original maps produced in color by Rick McLean, C-Zone Consulting, Ltd. and Shaun DeBru, GIS306 NE, Inc. Digitized by NOAA Coastal Services Center at the University of Maryland. NOAA provides census data and mapping tools. \*Mullins, G.E., Fleen, J.E. and Birch, W.R., Jr. (2006). Map projection: Albers equal area.

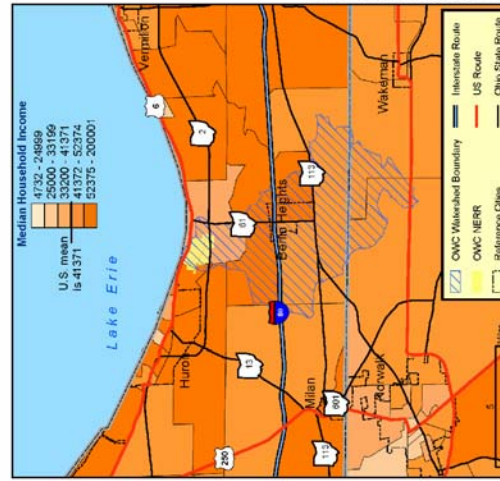
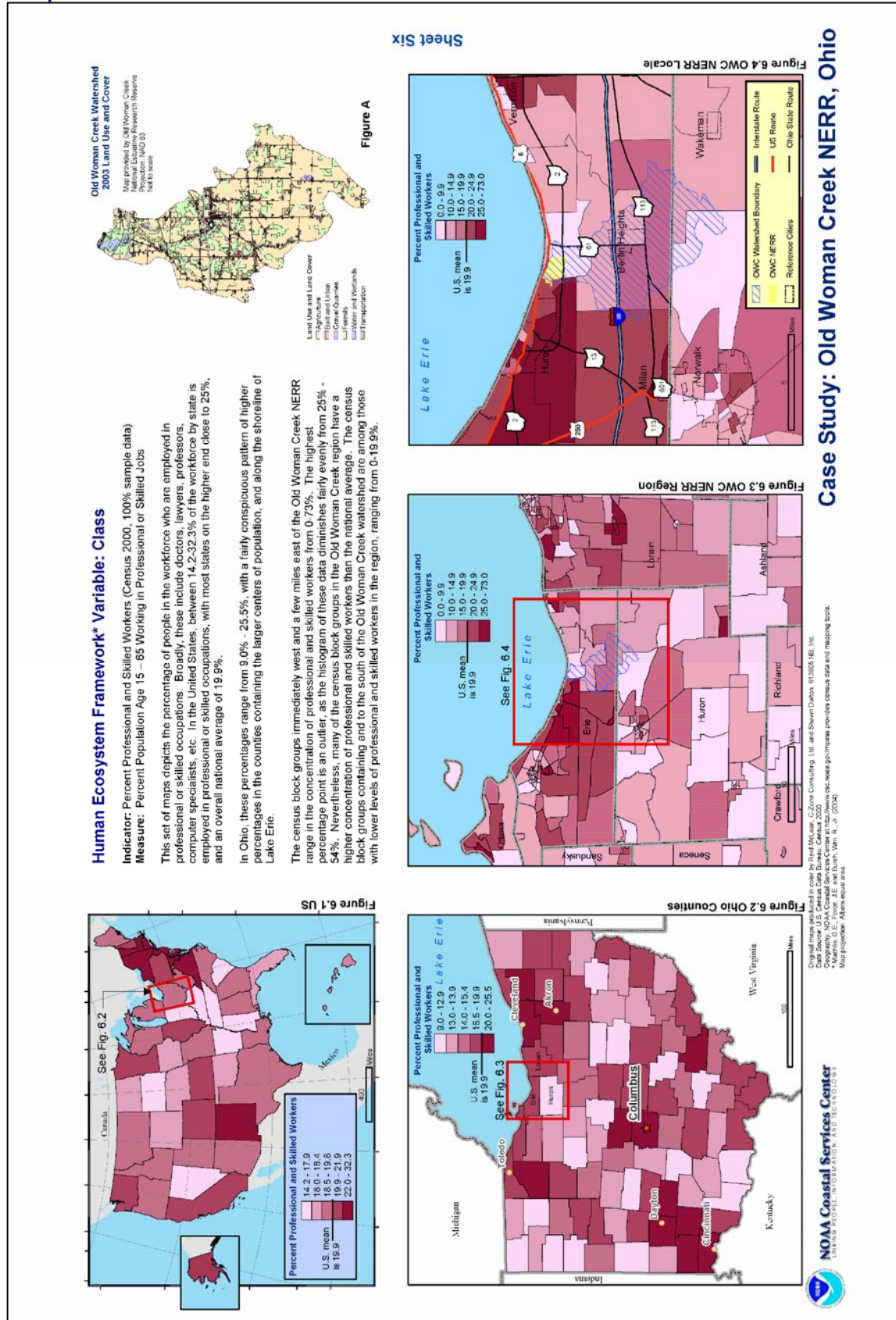


Figure 5.4 OWC NERR Locale

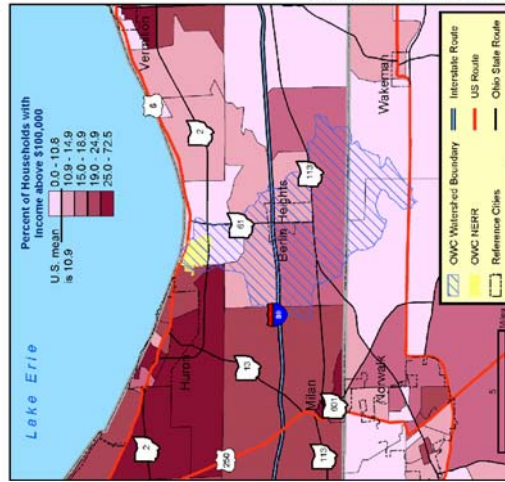
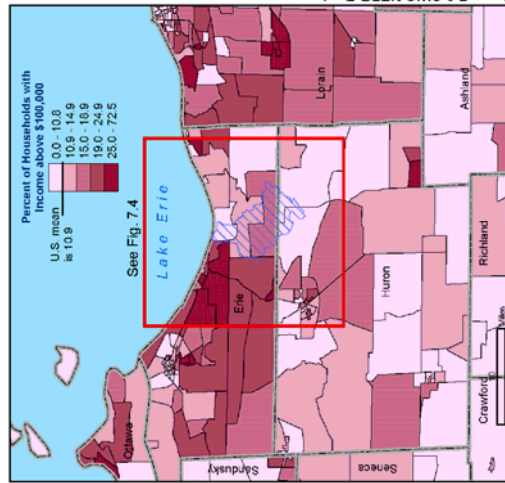
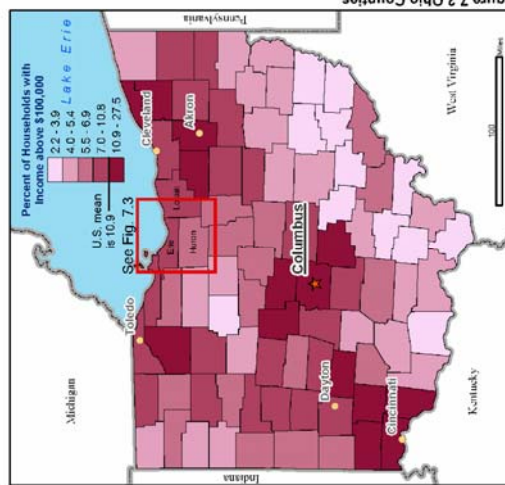
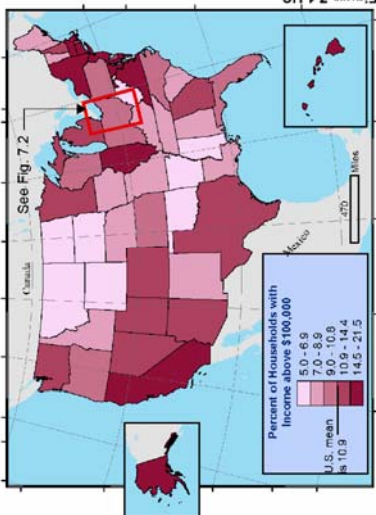
Sheet Five

## Case Study: Old Woman Creek NERR, Ohio

Map 6: Class



# Map 7: Power



**Human Ecosystem Framework\* Variable: Power**

**Indicator/Measure:** Percent of Households with Income Over \$100,000 (Census 2000, 100% sample data)

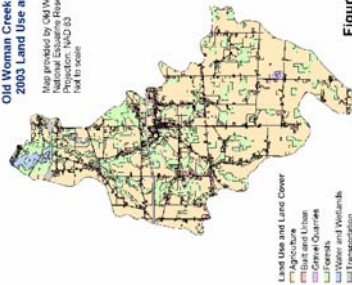
Power can be defined as the ability to influence the allocation and distribution of resources, and is often associated with one's financial status. In these maps, power is displayed as a function of income, with household earnings of \$100,000 per year or more considered to be influential. At the national level, power is concentrated on our coasts, in particular the northeast. The national average is 10.9% of households in this annual income range.

In Ohio, the concentration of households by county with this income level displays a wider range (2.2-27.5%) than the national data (5.0-21.5%), with a pattern of higher concentration of power in the centers of population.

In the region around Old Woman Creek NERR, the percentages of households with income levels of \$100,000 or more tend to be lower, with the exception of the areas immediately to the west of the Reserve. In the Old Woman Creek watershed, block groups at this income level range from 0.0 - 18.9%.

**Old Woman Creek Watershed 2003: Land Use and Cover**

Map provided by Old Woman Creek Watershed Research Institute, Piquette, OH 44851. Not to scale.



Sheet Seven

Original maps produced in color by Reed Muehlen, C.Zone Consulting, Ltd. and Steven Dalton, ©1995 HB, Inc. Digitized by NOAA Coastal Services Center at <http://www.csc.noaa.gov/maps>. NOAA Coastal Services Center provides census data and mapping tools. \*Adapted from: Fove, J.E. and Burn, W.R., Jr. (2004). Map projection: Adobe Acrobat.



## Case Study: Old Woman Creek NERR, Ohio



# Map 8: Wealth

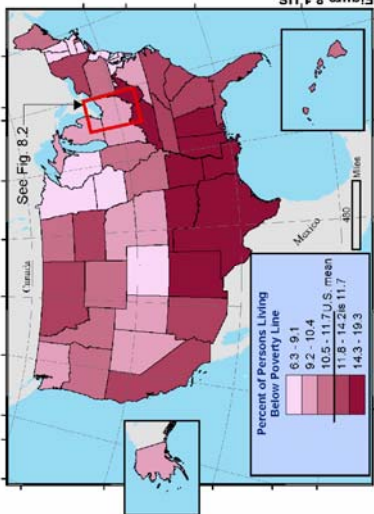


Figure 8.1 US

**Human Ecosystem Framework\* Variable: Wealth**  
**Indicator/Measure:** Percent Persons Living Below Poverty Line (Census 2000, 100% sample data)

Nearly 36 million people in the United States are living below the poverty line, defined as an annual income of \$18,660 or less for a family of four. In most of the southern states, 14.3-19.3% of the population is living below the official poverty line. In Ohio, there is a clear pattern of high poverty counties in the southeastern part of the state, and more counties with poverty rates below 7% in the western region of the state.

The counties around the Old Woman Creek NERR have relatively low average poverty rates. However, the block groups around the Reserve display the full range of poverty rates, from 0-16% and above. No strong spatial pattern is apparent in the regional or locale maps: areas of high poverty and low poverty rates are immediately adjacent to one another. However, moving inland and south, a slight trend from relatively low to relatively high poverty rates emerges. The census block group in which the Old Woman Creek NERR is located is among those with the highest poverty rates along the coast of Lake Erie.

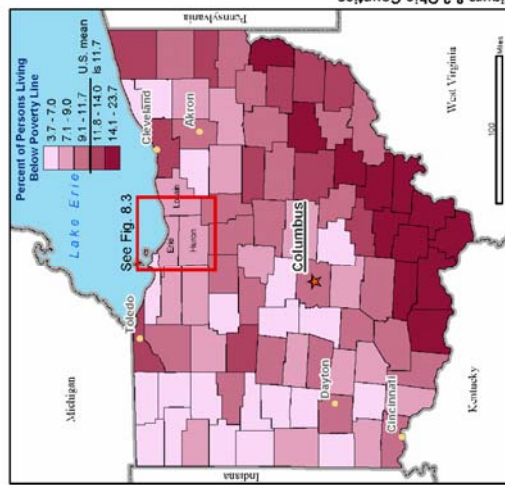


Figure 8.2 Ohio Counties

Original map produced in color by Reed Mitchell, C-Zone Consulting, Ltd. and Shawn Dalton, ©1995 IHS, Inc.  
 Digitally remapped by NOAA Coastal Services Center at <http://www.csc.noaa.gov/mse/ncsc> provides census data and mapping tools.  
 \*Mackin, G.E.; From J.E. and Shum, Wm. R., Jr. (2004).  
 Map projection: Albers Equal Area

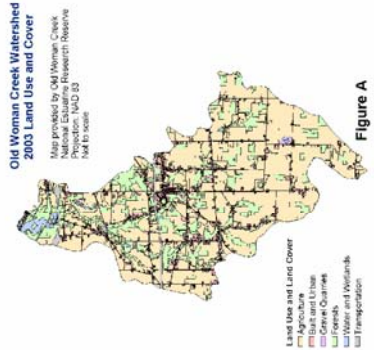


Figure A

**Old Woman Creek Watershed**  
**2003 Land Use and Cover**  
 Map provided by Old Woman Creek National Research Reserve  
 Prepared by NOAA, 2003  
 Not to scale

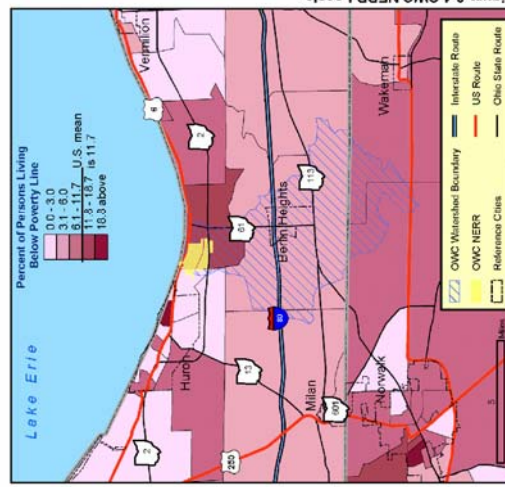


Figure 8.3 OWC NERR Region

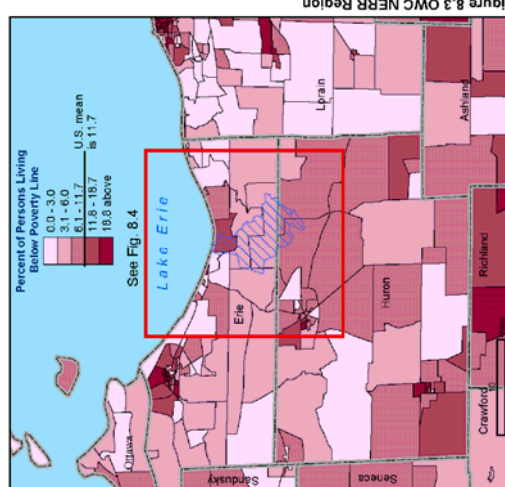
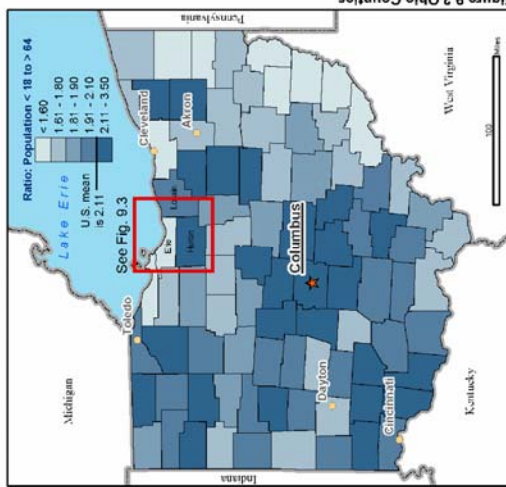
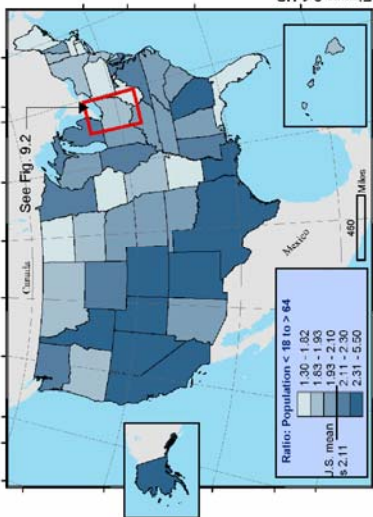


Figure 8.4 OWC NERR Locale

## Case Study: Old Woman Creek NERR, Ohio

# Map 9: Institutional Cycles



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Geography, NOAA Coastal Services Center at <http://www.csc.noaa.gov/imagery> provides census data and mapping tools.  
Map labels: U.S. map by J.E. and S. Wain, W. R., J., (2004).  
Map projection: Albers Equal Area

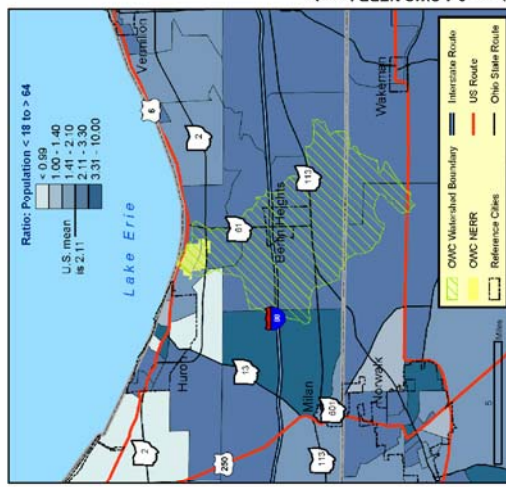
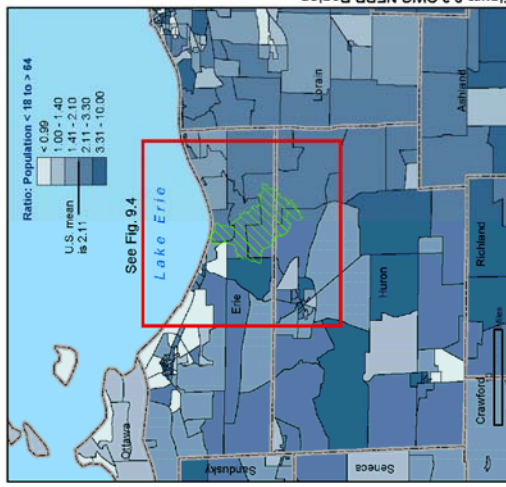
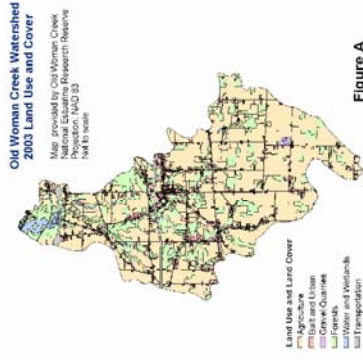
**Human Ecosystem Framework\* Variable: Institutional Cycles**

**Indicator:** Age Distribution  
**Measure:** Ratio of Population Age <18 - age > 64 (Census 2000, 100% sample data)

Institutional cycles are influenced by the relative distribution of age within a population. These maps display the ratio of young persons (age <18) to the elderly (age >64) by census geography. In the southwest United States, there is a relatively high ratio of young people to older people, ranging from 2.31 - 5.5; in the northeast and central states, the ratio is lower, ranging from 1.3 - 1.93. The national average is 2.11.

In Ohio, counties with the highest ratios are those containing centers of population, where the range in ratios is 2.1-3.5. There are two exceptions to this trend, the counties in which Cleveland and Akron are located. However, the counties immediately surrounding these show high ratios of children to elderly.

In the census block groups in the region of the Old Woman Creek NERR, ratios range from less than 1 to 10; the highest concentration of children is to the southwest of the Reserve. In the census block group where Milan is located. Immediately to the west of the Reserve, and further west along the coast of Lake Erie, the block groups are among those with the lowest ratio of children to elderly.



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Geography, NOAA Coastal Services Center at <http://www.csc.noaa.gov/imagery> provides census data and mapping tools.  
Map labels: U.S. map by J.E. and S. Wain, W. R., J., (2004).  
Map projection: Albers Equal Area

Sheet Nine

# Map 10: Energy

## Human Ecosystem Framework\* Variable: Energy

**Indicator:** Time Travelled to Work  
**Measure:** Percent Commuters Travelling 15-44 minutes to Work (Census 2000, 20% sample data)  
 Every day in the United States, approximately 128.3 million people get up and go to work. Some (3.3%) work at home, the vast majority however, drive to work alone (76%). The time travelled to work varies within and between regions. In many eastern and southern states, 15-25% of commuters drive over 45 minutes to get to work. In the Midwest and central northern states, 37-55% of commuters drive less than 15 minutes to get to work. Most commonly, however, Americans drive between 15 and 45 minutes to reach their place of employment; by state, the national average percent of commuters driving 15-45 minutes to work is 51.2%.

Ohio differs little from the rest of the country in this regard. In the counties spanning the southwestern and northeastern regions of the state, 54.9-64.7% of commuters spend between 15 and 45 minutes traveling to work. These are the most densely populated areas of the state, and include centers of population such as Cincinnati, Dayton, Columbus, Akron, and Cleveland.

In the region around the Old Woman Creek Watershed, higher proportions of commuters spend 15-45 minutes traveling to work: 60.5-77.3%. These counties contain 41% of the population of the state, but only 10% of the census tracts to the west. Relatively few people work at home in the watershed (<2% of the region (no more than 13.2%).

**Table 10.1 Means of Transportation**

Means of Transportation	United States	Ohio	Old Woman Creek Watershed
Drive alone	76%	82.30%	84%
Carpool	10%	8.50%	Other (e.g. bicycle)
Public transportation	4.75%	2.1%	Not used at home
			3.35%
			2.00%
			1.00%
			2.00%

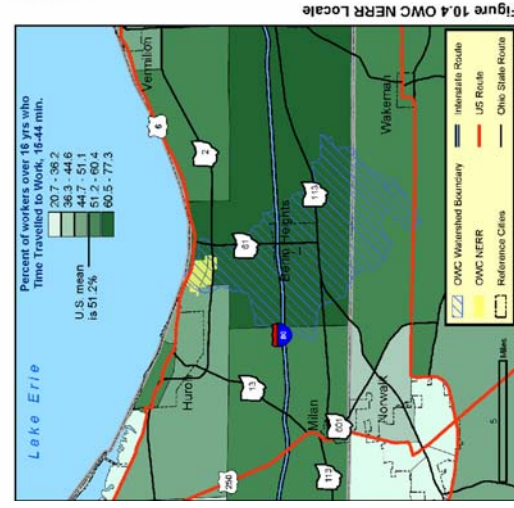
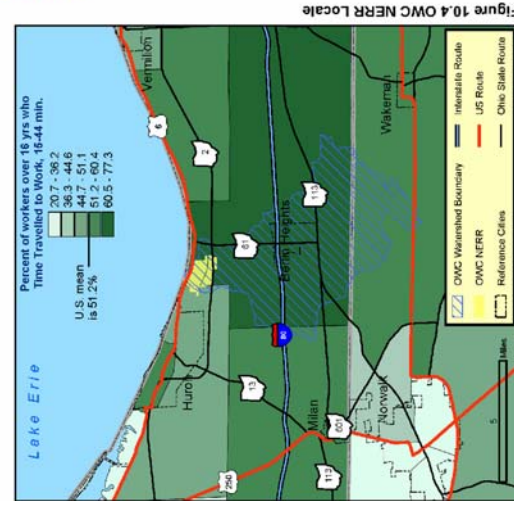
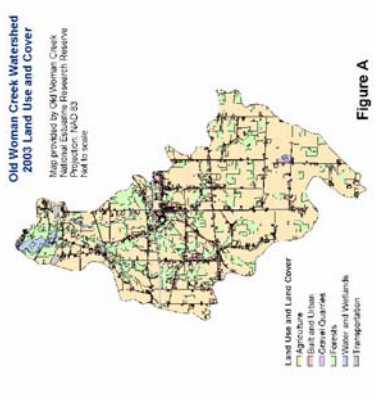
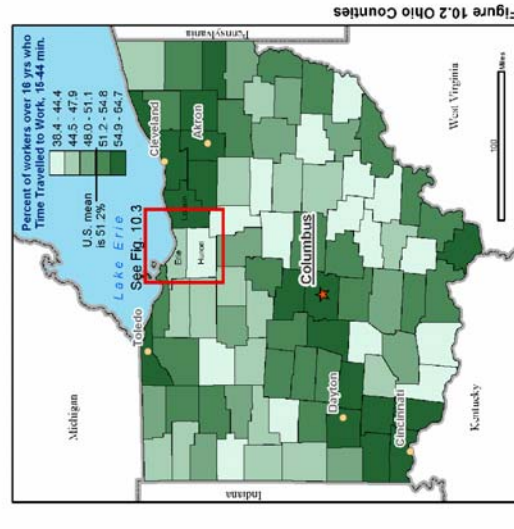
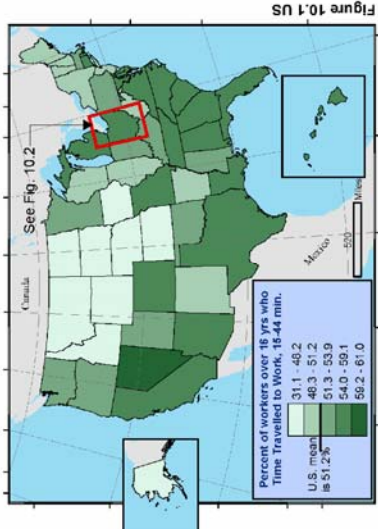


Figure 10.1 US  
 Figure 10.2 Ohio Counties  
 Figure 10.3 OWC NERR Region  
 Figure 10.4 OWC NERR Locale  
 Figure A  
 Sheet Ten

Original maps produced in collaboration with: Reed Muesel, CZM Consulting, Ltd. and Sherrill Dutton, GIS/DB/IE, Inc.  
 Geographical Information Systems Center at <http://www.csc.wisc.edu/geogis/geogis.html> previous census data and mapping tools.  
 Map prepared: Anna Rappaport



# Map 11: Informal Norms

## Human Ecosystem Framework\* Variable: Informal Norms

**Indicator:** Percent Single-Parent Household  
**Measure:** Percent of Households with Own Children Under 18 Years Living at Home, Headed by Single Parent (male or female)

In the United States, 25.8% of households with children under 18 years old living at home are headed by single parents. These include not only divorced parents, but also those who were never married, as well as widowed persons. There is a higher concentration of single-parent-headed households in the north central and northeastern states, ranging from 25.8% - 29.3%, than in the south and west (with the exception of Florida), ranging from 17.5% - 25.7%.

In Ohio, the distribution of these rates is slightly greater than national rates, ranging from 15.8% - 33.0%. There is a higher concentration of single-parent-headed households in the southeastern region of the state, as well as in the north central.

In the region around the Old Woman Creek NERR, there are relatively high rates of single-parent-headed households, up to 64.5%, to both the east and west. In the census block groups in the Old Woman Creek watershed, and containing the Reserve itself, however, these rates are among the lowest in the State, ranging from 11.3% - 17.5%.

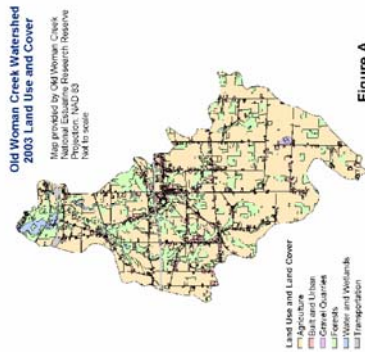
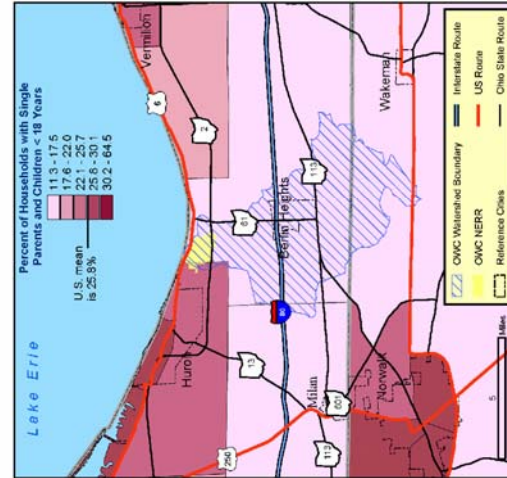
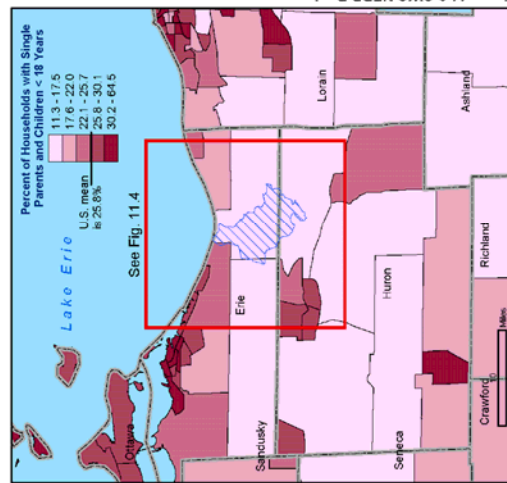
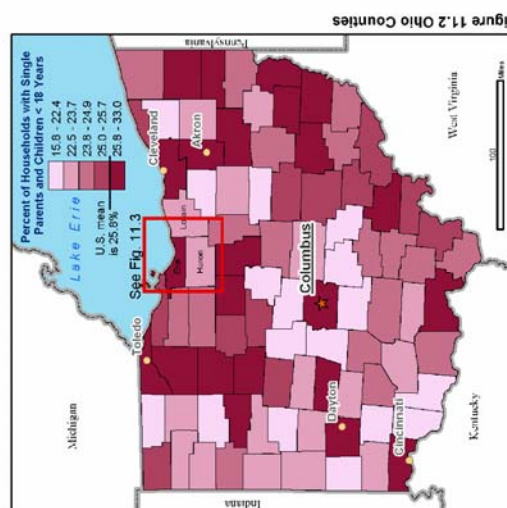
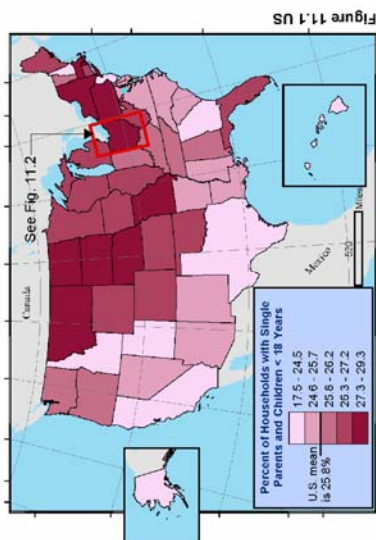


Figure A

Sheet Eleven



Original maps produced in collaboration by Reed Muesel, CZone Consulting, Ltd. and Steven Dalton, GIS@CSE, Inc.  
 Geographical Information Systems Center at <http://www.csc.wisc.edu/geographic-services> census data and mapping tools.  
 Muesel, S.E., Peter J.E. and Dalton, W.R., Jr. (2004).  
 Map prepared under request.



## Case Study: Old Woman Creek NERR, Ohio

## G. Bibliography

- Abercrombie, N., S. Hill, & Turner, B. S. (1988). *The Penguin Dictionary of Sociology*. 2d ed. New York: Penguin Books.
- Bidwell, C. E., & Friedkin, N. E. (1988). The sociology of education. Pp. 449-471 in N. J. Smelser, (1988). *Handbook of Sociology*. Newbury Park: Sage Publications
- Boudon, R., & Bourricaud, F. (1989). *A Critical Dictionary of Sociology*. Chicago: University of Chicago Press.
- Burch, W. R, Jr. (1971). *Daydreams and Nightmares: A Sociological Essay on the American Environment*. New York: Harper and Row.
- Burch, W. R, Jr., & DeLuca, D. R. (1984) *Measuring the Social Impacts of Natural Resource Policies*. Albuquerque: University of New Mexico Press.
- Bormann, F. H., D. Balmori, & G. T. Geballe. (1993). *Redesigning the American Lawn*. New Haven, CT: Yale University Press.
- Bormann, F. H., and G. Likens. (1979). *Patterns and Processes in a Forested Ecosystem*. New York: Springer-Verlag.
- Caro, R. A. (1974). *The Power Broker: Robert Moses and the Fall of New York*. Alfred a Knopf Inc.
- Cheek, N. H., Jr., & Burch Jr., W. R. (1976). *The Social Organization of Leisure in Human Society*. New York: Harper and Row.
- Clapham, W. B., Jr. (1998). *Human Ecosystems*. New York: Macmillan.
- Cottrell, F. (1955). Energy and society: The relation between energy, social change, and economic development. In *Handbook of Modern Sociology*, ed. F. Robert. New York: Rand McNally.
- Dunlap, R. E., Kraft, M. E. & Rosa, E. A. (1993). *Public Reactions to Nuclear Waste*. Durham, NC: Duke University Press.
- Durkheim, E. (1938). *The Rules of Sociological Method*. 8<sup>th</sup> ed. New York: The Free Press.
- Durkheim, E. (1933). *The Division of Labor in Society*. Glencoe, IL: The Free Press.
- Eckaus, R. S. (1972). *Basic Economics*. Boston: Little, Brown and Company.
- Eisenstadt, S. N. (1956). *From Generation to Generation*. Glencoe, IL: The Free Press.

- Field, D. R., & Burch, Jr., W. R. (1988). *Rural Sociology and the Environment*. Middleton, WI: Social Ecology Press.
- Geertz, C. (1963). *Agricultural Involution*. Berkeley, CA: University of California Press.
- Goode, W. J. (1978). *The Celebration of Heroes: Prestige as a Social Control System*. Berkeley: University of California Press.
- Hawley, A. H. (1986). *Human Ecology: A Theoretical Essay*. Chicago: University of Chicago Press.
- Hawley, A. H. (1950). *Human Ecology: A Theoretical Community*. New York: The Ronald Press.
- Jary, D. & Jary, J. (1991). *The Harper Collins Dictionary of Sociology*. New York: Harper Perennial.
- Lenski, G. E. (1984). *Power and Privilege: A Theory of Social Stratification*. Chapel Hill: The University of North Carolina Press.
- Machlis, M. G., & Burch, Jr., W. R. (1983). Relations between strangers: Cycles of structure and meaning in tourist systems. *Sociological Review* 31(4): 666-692.
- Malinowski, B. (1948). *Magic, Science and Religion and Other Essays*. Glencoe, IL: The Free Press.
- Mann, M. (1984). *The Sources of Social Power: Volume 1, A History of Power from the Beginning to A.D. 1760*. New York: Cambridge University Press.
- Morales, E. (1989). *Cocaine: White Gold Rush in Peru*. Tucson, AZ: The University of Arizona Press.
- Rawls, J. (1971). *A Theory of Justice*. Cambridge: The Belknap Press of Harvard University Press.
- Reisner, M. (1986). *Cadillac Desert: The American West and Its Disappearing Water*. New York: Penguin Books.
- Rodwin, V. G. (1984). *The Health Planning Predicament: France, Quebec, England and the United States*. Berkeley: University of California Press.
- Rosa, E. A., Machlis, G. E. & Keating, K. M. (1988). Energy and society. *Annual Review of Sociology* 14:149-172.
- Schor, J. B. (1992). *The Overworked American: The Unexpected Decline of Leisure*. New York: Basic Books.

- Scialfa, M. (1992). *An Ethnographic Analysis of Poachers and Poaching in Northern Idaho and Eastern Washington*. Master's thesis, University of Idaho, Moscow.
- Shell, K. L. (1994). *The Democratic Political Process*. Waltham, MA: Blaisdell.
- Theodorson, G. A., & Theodorson, A. G. (1969). *Modern Dictionary of Sociology*. New York: Thomas Y. Crowel Company.
- Thompson, P. (1983). *The Nature of Work: An Introduction to Debates on the Labour Process*. London: Macmillan.
- Turner, B. L., II, Clark, W. C., Kates, R. W., Richards, J. F., Mathews, J. T. & Meyer, W. B. (eds.) (1990). *The Earth as Transformed by Human Action: Global and Regional Changes in the Biosphere over the Past 300 Years*. Cambridge: Cambridge University Press with Clark University.
- von Bertalanffy, L. (1968). *General System Theory*. New York: Braziller.
- Weber, M. (1930). *The Protestant Ethic and the Spirit of Capitalism*. London: Allen & Unwin.
- Weitz, S. (1977). *Sex Roles: Biological, Psychological and Social Foundations*. New York: Oxford University Press.
- West, P. C. (1982). *Natural Resource Bureaucracy and Rural Poverty: A Study in the Political Sociology of Natural Resources*. Ann Arbor: University of Michigan.
- Wilson, E. O. (1992). *The Diversity of Life*. New York: W. W. Norton and Company.
- Wilson, E. O. (1978). *On Human Nature*. Cambridge: Harvard University Press.
- Wilson, E. O. (1975). *Sociobiology: The New Synthesis*. Cambridge: The Belknap Press of Harvard University Press.
- Worster, D. (1992). *Under Western Skies: Nature and History in the American West*. New York: Oxford University Press.
- Wrong, D. H. (1994). *The Problem of Order: What Unites and Divides Society*. New York: The Free Press.
- Wrong, D. H. (1988). *Power: Its Forms, Bases, and Uses*. Chicago: University of Chicago Press.
- Zelinsky, W. (1973). *The Cultural Geography of the United States*. Englewood Cliffs, NJ: Prentice-Hall.





**Old Woman Creek NERR  
Management Plan**

**APPENDIX J**

**Ohio CTP Strategic Plan, 2009-2012**

## Ohio Coastal Training Program Strategic Plan 2009-2012

This document updates the strategic plan of the Ohio Coastal Training Program (CTP). The plan reflects input from targeted decision-makers across the Lake Erie watershed, the Ohio Coastal Training Program Executive Committee and staff of core partners: Ohio Department of Natural Resources Division of Wildlife - Old Woman Creek National Estuarine Research Reserve (OWC NERR), Ohio Department of Natural Resources Office of Coastal Management (OCM), Ohio Sea Grant College Program (OSG), and the Ohio Lake Erie Commission (OLEC). Building on the program's successes and lessons learned, the plan outlines the programmatic goal, along with outcomes and objectives to address the priority training needs of local government officials and other decision-makers across the Lake Erie watershed over the next three years. Program priorities may be adjusted to respond to changes in the training market or emerging issues identified through ongoing needs assessments.

### **II. Program Context**

#### *Programmatic*

The mission of the Ohio Coastal Training Program (CTP) is to enhance stewardship of Lake Erie by providing science-based training and technical assistance to professionals, officials, and volunteers who make decisions that impact the Lake and its watershed. The Ohio CTP serves decision-makers in thirty-four counties across northern Ohio. Since its inception in 2004, the program has trained over 1,700 decision-makers and professionals on topics such as best practices for land use planning, stormwater management, invasive species management, and oil spill response (See Appendix A for complete list). It has provided technical assistance to secure a four-year grant for community-based watershed planning and conducted studies to assess the training needs of local government officials.

Ohio CTP courses and products are targeted to specific roles and competency levels. Audience diversity is sought to maximize potential for interdisciplinary engagement and collaborative problem solving but is also balanced against the need to provide information and skill building opportunities applicable to the professional or decision-making roles of participants. To date, local and county officials have represented the majority of participants followed by businesses and non-profit organizations. Efforts have centered on enhancing the core partnership through communication and project-based collaboration, building external partnerships, and refining the Ohio CTP's issue and audience focus.

#### *Ecological and Social*

Lake Erie, the shallowest, smallest, southernmost, and most biologically productive of all the Great Lakes is subject to the largest impacts from urbanization and agriculture. With over 12 million people living in its watershed, demands on and impacts to the Lake and the natural resources of its basin are great. Although water quality has significantly improved through investment in

point source reduction; nonpoint source pollution from agricultural and urban landscapes remains a major cause of water quality degradation. Sediment is the primary nonpoint pollutant of concern, followed closely by nutrient enrichment and habitat modification.

Sprawling development is a major contributor to the challenge of nonpoint pollution. Across Ohio in the period 1960-1990 there was a five percent increase in the conversion of green space to urbanized land use for every one percent increase in population. Associated increases in impervious surfaces directly impact Lake Erie and its tributaries by intensifying stormwater runoff events and degrading aquatic habitat. Communities also experience secondary impacts in the form of higher individual tax burdens, reduced quality of infrastructure and government services, and lost sense of place (LEPR, 2008).

Failing home septic systems and combined sewer and sanitary sewer overflows lead to beach closures and coastal erosion problems and also impact the quality of near shore areas along Ohio's 312 miles of Lake Erie coast. In addition to the direct negative impact on health and property, secondary impacts include reduced property values, lower tourism rates, and a persistent negative view of the value of the Great Lakes (LEPR, 2008).

Ohio is a home rule state. Land use decisions are made at the local level by appointed and elected officials and administrative employees. To address nonpoint source pollution and other pressing issues impacting Lake Erie, local officials need scientific information related to the impacts of land use and development on water quality, an understanding of the economic benefits of environmental stewardship, and the technical knowledge and tools to implement best practices to minimize impacts on water resources through local plans and regulations.

### **III. Current and Anticipated Partnerships**

The Ohio CTP leverages the scientific and resource management expertise of four core partners to provide and enhance training and technical assistance for Lake Erie watershed decision-makers. The program is administered by OWC NERR staff and guided by an Executive Committee consisting of representatives from each partner program. The Ohio CTP also collaborates and coordinates with a wide range of additional government, university, and non-profit partners. (See Appendix B for description of core partner programs and complete partner list)

#### **IV. Contribution to Goals and Objectives of Old Woman Creek National Estuarine Research Reserve**

The mission of OWC NERR is to improve the understanding and stewardship of Great Lake estuaries and coastal wetland ecosystems. The Reserve's primary goal involving the Ohio CTP is to inform decisions of Lake Erie communities and individuals regarding coastal ecosystems. The Ohio CTP also contributes to three other Reserve goals:

- Improve scientific understanding of the estuary, watershed, and Lake Erie
- Foster connections to the Old Woman Creek estuary and other coastal ecosystems
- Enhance the OWC NERR's role as a regional focal point for wetland stewardship science, practice implementation, and education

The Ohio CTP also supports several integrated objectives linked to the Reserve goals:

- Reserve Objective: *Reserve ecological conditions are monitored and indicators are developed to provide a foundation for management-oriented research and estuarine education*
  - By providing science-based training and information regarding the value, ecology, and stewardship of Lake Erie.
- Reserve Objective: *Reserve science and technical expertise is transferred to estuarine stakeholders*
  - By facilitating connections between decision-makers and scientists, including transfer of research results and user engagement in the research process.
  - By hosting training events and/or field experiences at the Reserve.
  - By working with Reserve research and stewardship and others to implement and monitor land use and stormwater best practice research demonstrations and providing training for decision-makers focused on the design and performance of these practices.
- Reserve Objective: *3,000 coastal decision-makers receive science-based training and information that supports coastal stewardship*
  - Through increasing scientific understanding and skills among decision-makers and assisting them in implementing best practices to protect Lake Erie, its coast, and watershed.
- Reserve Objective: *The effectiveness of Research education programs is measured by needs assessment and evaluation strategies*
  - By using research-based practices to develop and implement decision-maker training programs and by coordinating the training efforts of Ohio NOAA programs, the Ohio Lake Erie Commission and other training providers in the Lake Erie basin.

## V. Guiding Principles

The following principles adapted from the Environmental Education Council of Ohio's *Best Practices for Environmental Education* (Meredith, 2000) will guide development of Ohio CTP courses, products, and services:

1. Recognize that decision-makers build upon prior knowledge and experience to construct their own knowledge of Lake Erie through investigation, discussion, and application.
2. Employ a hands-on, minds-on approach, which includes physical involvement, problem-solving, decision-making, reasoning, and/or creative thinking to build awareness, understanding, and skills needed to address Lake Erie watershed challenges.
3. Engage decision-makers in program planning, design, marketing, and evaluation.
4. Engage informed decision-makers as training facilitators and instructors.
5. Foster cooperative and collaborative learning among diverse decision-making roles.
6. Develop programs that actively engage participants through case studies, simulations, small group discussions, and field experiences.
7. Employ assessment and evaluation tools to adaptively manage the program.
8. Present accurate and inter-disciplinary information and maintain a balance of viewpoints.
9. Design programs that go beyond information transfer to build comprehensive awareness, knowledge, and skills for making informed decisions and acting to solve environmental problems.
10. Connect with decision-makers through multifaceted marketing and communication.

## VI. Mission, Goals, and Objectives

**Mission:** Enhance stewardship of Lake Erie by providing science-based training and technical assistance to professionals, officials, and volunteers who make decisions that impact the Lake and its watershed.

**Goal:** To inform decisions for the stewardship of Lake Erie and balanced growth in its watershed.

**Outcomes** (See Appendix F for logic model)

- Lake Erie watershed decision-makers:
  - Possess the science-based knowledge and skills needed to make informed decisions. (S1)
  - Are exposed to multi-disciplinary and organizational perspectives related to Lake Erie issues.(S2)
  - Recognize the environmental, economic, and social value of Lake Erie. (S3)
  - Understand the impact of their decisions on Lake Erie and its watershed. (S4)

- Take action to protect and restore Lake Erie and watershed ecosystems. (M1-5, L1)
- A coordinated and efficient training market that meets the needs of decision-makers in the Lake Erie watershed. (S5, M6, L2)
- The scientific community is aware of decision-maker information needs, conducts research to address them, and engages decision-makers in applied research related to Lake Erie resource management challenges. (S6, M7, L3)

***Decision-makers possess science-based knowledge and skills necessary to make informed decisions regarding Lake Erie and watershed issues. (S1)***

Objectives:

1. Offer ten courses or technical assistance programs focused on stormwater and watershed management, balanced growth, sustainable design and construction, renewable energy, and shore erosion management annually through June 2012.
2. Develop a climate change toolbox for decision-makers including science, regional impacts, and adaptation and mitigation measures by June 2010.
3. Incorporate research documenting the water quality performance of stormwater practices in materials and website by June 2010.
4. Develop and offer one course focused on climate change adaptation or mitigation by January 2011.
5. By 2012, 75% of surveyed participants indicate they have applied science-based knowledge or skills gained through a CTP program or service in their decisions or professional actions.

***Decision-makers are exposed to multi-disciplinary and organizational perspectives related to Lake Erie issues. (S2)***

Objectives:

1. Design courses and services that facilitate cross-disciplinary dialogue and problem solving related to land use and stormwater management challenges through June 2012.

***Decision-makers recognize the environmental, economic, and social value of Lake Erie. (S3)***

Objectives:

1. Develop a bibliography of research on the economic benefits of natural resource protection by June 2010.
2. Incorporate information on the environmental, economic, and social value of Lake Erie and coastal ecosystems in all training and technical assistance by January 2011.
3. By 2012, at least 80% of surveyed participants will be able to list three major ecosystem services of streams, coastal wetlands, or Lake Erie.
4. By 2012, at least 80% of surveyed participants will be able to explain the environmental, economic, and social value of Lake Erie for coastal communities and Ohio citizens.

***Decision-makers understand the impact of their choices on Lake Erie and its watershed. (S4)***

Objectives:

1. Provide three courses or technical assistance programs annually to increase understanding of land use impacts on Lake Erie and build capacity to implement best practices for planning and development.
2. Provide at least one course annually focused on decision support tools and models that predict land use impacts on water quality.
3. By June 2012, at least 80% percent of participants demonstrate an understanding of how local land use, development, and infrastructure decisions impact Lake Erie.

***A coordinated and efficient training market that meets the needs of decision-makers in the Lake Erie watershed. (S5, M6, L2)***

Objectives:

1. Core partners meet quarterly to discuss training needs, priorities, outcomes, and collaboration opportunities through June 2012.
2. Develop a program charter defining the roles of core partners by January 2010.
3. Establish an external advisory council by June 2010.
4. Create a website to coordinate marketing, provide on-line registration, and serve as a portal to scientific information and tools by January 2011.
5. Publish an electronic newsletter featuring training programs and decision-support resources by June 2010.
6. Seek funding to expand staff by June 2011.
7. Convene and participate in training consortiums related to priority issues through 2012.
8. Form at least three new partnerships with colleges and universities by June 2012.
9. Facilitate one "train the trainer" course for core partners and other training providers by June 2012.
10. Core partners appoint staff to needs assessment, training program, and product development workgroups through June 2012.
11. Assess the training needs of local officials related to grant writing for environmental projects and pilot one course by December 2009.
12. Assess decision-maker training and information needs related to climate change by June 2010.

***The scientific community is aware of decision-maker needs, conducts research to address them, and engages decision-makers in applied research related to Lake Erie management challenges. (S6, M7, and L3)***

Objectives:

1. Collaborate with the OWC NERR Research Coordinator and others in the scientific and decision-making communities to organize a science, management, and policy symposium on coastal wetlands of the lower Great Lakes by June 2011.
2. By June 2010, requests for proposals issued by Ohio CTP partners include decision-maker needs, and proposals addressing these needs and engaging decision-makers in the research process are prioritized.
3. By June 2012, communicate decision-maker information needs related to land use, development, and climate change to entities that fund Lake Erie research.
4. By June 2012, facilitate engagement of decision-makers in applied research regarding best practices for land use planning and watershed management.

***Lake Erie and watershed ecosystems are protected and restored. (M1-5, L1)***

Objectives:

1. Conduct an evaluation to assess the Ohio CTP's impact on decision-making by December 2011.
2. By June 2012, 100 decision-makers have taken action to protect or restore Lake Erie and attribute this in part to knowledge, skills, or perspectives gained through the Ohio CTP.

## **VII. Priority Audiences**

Although the Ohio CTP may provide or support training for all coastal decision-makers (professionals, officials, or volunteers who make decisions impacting Lake Erie and its watershed); local government officials are the program's primary target audience. For the purposes of this plan, a local official is defined as an individual that serves in an elected, appointed, or administrative capacity at the township, municipal, or county level. A local official may also be a private consultant contracted by a community to perform services such as municipal engineering.

Local officials affect coastal and watershed resources through land use, infrastructure, and economic development decisions. While their decisions are key to ecosystem protection, local officials may tend to undervalue ecosystem protection – viewing environmental quality as a source of expenditures while not being aware of the economic benefits and cost or risk avoidance that accrue from healthy ecosystems (Kellogg, 2006). In order to sustain a healthy Lake Erie, local officials need to understand the relationship between land use and water quality, possess technical knowledge regarding best practices for planning and development, and be aware of the economic, environmental, and social benefits of implementing such practices.



## VIII. Priority Issues and Training Needs

An initial Ohio CTP needs assessment (Kellogg, 2003) identified land use and water quality as priority training needs and local officials as a potentially underserved audience in the Lake Erie basin. Additional watershed and coast-wide needs assessments have been conducted to obtain more detailed information on the training needs of local officials related to land use and water quality.

Local officials across the watershed are most interested in training on *stormwater and watershed management, wastewater treatment, source water protection, renewable energy technologies, and sustainable design and construction*. Officials in coastal communities also desire training on *shore erosion management* (Ohio CTP, 2008). The Ohio CTP has already begun to develop programs focused on stormwater, watershed management, renewable energy and land use, and shore erosion and will expand to address other key issues as program resources allow.

Local officials have indicated that they need training related to funding sources, grant-writing, and the economic benefits of environmental stewardship. These issues apply to multiple resource management challenges and will be integrated into all Ohio CTP products and services.

### *Focus Area: Stormwater*

Stormwater is a priority issue and training need for many local government roles, especially among engineers, stormwater coordinators, public service and works directors, and city/village councils. Challenges local officials face related to stormwater include funding, regulation compliance and enforcement, addressing flooding impacts, and cooperating with other communities. Highest-rated stormwater training topics by local officials, engineers, and other stormwater professionals attending a regional stormwater conference include maintenance, performance, and design of stormwater practices, writing stormwater pollution prevention plans, watershed planning, stream restoration, urban retrofits, and developing stormwater management ordinances: (See Appendix C for complete list)

The Ohio CTP has joined forces with the Ohio EPA and over a dozen other agencies and organizations as a regional training council to provide consistent messages and high quality training opportunities to meet the needs of stormwater professionals, particularly municipal separate storm sewer system (MS4s) operators. The program coordinator is working with the council to develop a strategic plan informed by Ohio CTP needs assessments and establish a mini-grant program to fund collaborative stormwater training efforts.

A national training course for engineers and other technical professionals on the water quality performance of post-construction stormwater treatment practices has been developed by the University of New Hampshire Stormwater Center and NOAA Coastal Services Center. The Ohio CTP participated in course design, including hosting a focus group to gather input on content and format from

stormwater professionals in northern Ohio. The Ohio CTP is coordinating with the training council to pilot a preliminary version of this training in August 2009.

*Focus Area: Watersheds Management and Land Use Planning*

Land use planning is a priority issue for many local government officials including planners, engineers, county commissioners, zoning commissions, and legal staff. Addressing land use change, updating and enforcing zoning, adopting sustainable development practices, and managing conflict are some of the land use challenges that local officials face. Decision-makers have indicated they are in need of more training on the legal and environmental aspects of land use, smart growth and other land use planning tools (Ohio CTP, 2008). The Lake Erie Protection and Restoration Plan (Ohio Lake Erie Commission, 2008) calls for a fundamental change from making land use, energy use, and development decisions in isolation to holistic, regional approaches that consider ecological and human dimensions. Ohio's Balanced Growth Strategy sets out principles and state incentives to encourage communities to link land-use planning with the health of watersheds. Using this framework, communities can cooperatively create watershed balanced growth plans that designate priority conservation areas (PCAs) and priority development areas (PDAs). A toolbox of 'best local land use practices' including model land use regulations has also been developed to assist communities in implementing balanced growth.

The Ohio CTP has previously assisted the Ohio Lake Erie Commission with development of a training program for local professionals on balanced growth and best local land use practices. Because the Ohio Lake Erie Commission is a core program partner, the Ohio CTP will serve as a direct vehicle and funding source to expand balanced growth training and technical assistance. In 2009-2010, the Ohio CTP partners will collaborate to develop technical case study-based training to enhance the ability of engineers to implement best land use practices for stormwater management.

*Focus Area: Lake Erie Shore Erosion*

Sand beaches that once fronted most reaches of the Ohio shore of Lake Erie have diminished due to the cumulative and secondary impacts of near shore armoring and offshore disposal of sand dredged from harbors that cut off sand supply to the littoral system. Despite numerous erosion control structures built to protect urban development, each year nearly 1.6 million tons of material is eroded along Ohio's lakeshore, with significant implications for public safety, health, and welfare. Lake Erie shore erosion results in extensive damage to property, beach and wetland loss, negative affects on water quality, habitat, and commercial and recreational opportunities.

The variability of the Lake Erie shore combined with significant lakefront development presents a unique coastal management challenge. To address this challenge, ODNR is developing a Lake Erie Shore Erosion Management Plan (LESEMP). The LESEMP will be a tool for local communities, individual property owners, and the Office of Coastal Management to use in addressing Lake Erie-based erosion and flooding concerns in conjunction with restoration of some coastal and near-shore habitats and resources.

*Focus Area: Lake Erie Shore Erosion*

Ohio CTP partners conducted a needs assessment of coastal communities and property owners with the aim of incorporating specific measures into the LESEMP and designing relevant training programs. Over 56% of public officials that responded were interested in training or assistance related to managing Lake Erie shore erosion. Top training issues included plans and permits for erosion control, financing options, best management practices, understanding shore erosion, and assistance with selecting qualified engineers and contractors (Lichtkoppler, 2008).

The LESEMP will be regional in scale and include natural types of erosion control and other Best Management Practices. The plan will provide a guidance document that provides solutions to erosion and flooding problems based on scientific research and historical data, the needs of coastal communities and property owners, and the need to protect and restore critical coastal resources. LESEMP guidance on shore erosion Best Management Practices, a coastal design manual for engineers, and a model ordinance for coastal protection will be incorporated into Ohio CTP services on coastal protection and restoration methods for contractors, design professionals, and public officials.

**IX. Emerging Issue: Climate Change**

The Ohio CTP will partner with others to evaluate needs and provide training to assist the region's decision-makers in taking action to reduce greenhouse gas emissions and adapt to the impacts of climate change. Programs will focus on the projected regional impacts of climate change and how decision-makers can:

- Reduce greenhouse gas emissions by increasing energy efficiency in buildings, switching to renewable energy sources, increasing vehicle fuel economy, and investing in mass transit.
- Minimize pressures on ecosystems by protecting habitat, the quality and supply of water resources, limiting urban sprawl, and improving air quality.
- Mitigate impacts of ecological changes— wetland migration, changing species ranges and lake levels.
- Plan and undertake adaptation measures for unavoidable climate change impacts.

The Ohio CTP will develop a toolbox for decision-makers consisting of resources on climate change science, regional impacts, adaptation, and mitigation. Two closely related topics (renewable energy and sustainable design) have already been documented as priority training needs among local officials and further needs assessment will be conducted to inform program design in these areas. Potential partners for climate change training include the Green City Blue Lake Institute, NOAA Climate Service, NOAA Coastal Services Center, Ohio EPA, Oberlin College, NatureServe, Green Energy Ohio, and the International Council for Local Environmental Initiatives.

## **X. Training Delivery System**

Ohio CTP training and technical assistance may be delivered by any of the four core partners following review and approval by the Executive Committee and pending collection of federally required performance measure data. External partnerships with government agencies, nonprofit organizations, and academic institutions will be cultivated to leverage resources for program design, marketing, and delivery. Decision-maker preferences and topical focus will drive selection of format and delivery methods (see Appendix D for format and delivery method preferences).

## **XI. Monitoring and Evaluation**

Achievement of short-term outcomes will be measured through participant evaluation surveys and other assessment techniques. Achievement of mid- and long-term outcomes will be measured through focus groups and interviews six months or more after participation, longitudinal research, and external program evaluation.

## **XII. Program Administration**

The Ohio Coastal Training Program is staffed by a coordinator employed by OWC NERR that devotes approximately 0.75 FTE to the program. Partner programs provide oversight and in-kind support by appointing staff to the program's Executive Committee (see Appendix E for membership), to needs assessment and course design teams, and by providing technical assistance with marketing and development of materials and publications.

## References

- Meredith, Joyce et al. 2000. *Best Practices for Environmental Education: Guidelines for Success*. Environmental Education Council of Ohio.  
[http://www.eric.ed.gov/ERICDocs/data/ericdocs2sql/content\\_storage\\_01/0000019b/80/1a/ad/85.pdf](http://www.eric.ed.gov/ERICDocs/data/ericdocs2sql/content_storage_01/0000019b/80/1a/ad/85.pdf)
- Kellogg, W.A., E. Methany, & M. McGoun. 2004. *Economic and Fiscal Aspects of Coastal and Watershed Stewardship Practices*. Final Report Lake Erie Protection Fund Grant # SG 212-03  
<http://www.lakeerie.ohio.gov/Portals/0/Closed%20Grants/small%20grants/sg212-03.pdf>
- Kellogg, W.A. et al. 2005. *Training Needs of Coastal Resources Decision Makers in Ohio's Lake Erie Basin*. Coastal Management, 33: 335-351.
- Lichtkoppler, F. and T. Archer. 2007. *Lake Erie Shore Erosion Management Plan Local Community Needs Assessment* from Ohio Department of Natural Resources Office of Coastal Management website:  
[http://www.dnr.state.oh.us/Coastal\\_Main\\_Menu/Programs/LakeErieShoreErosionManagementPlan/LESEMPNeedsAssessment/tabid/9293/Default.aspx#Written%20Public%20Official](http://www.dnr.state.oh.us/Coastal_Main_Menu/Programs/LakeErieShoreErosionManagementPlan/LESEMPNeedsAssessment/tabid/9293/Default.aspx#Written%20Public%20Official)
- Ohio Coastal Training Program. 2008. *Program Evaluation Summary: Northeast Ohio Stormwater Conference May 21-22, 2008* Prepared for: Tinkers Creek Watershed Partners and Chagrin River Watershed Partners. Available on Request from Old Woman Creek National Estuarine Research Reserve, 2514 Cleveland Road East Huron, Ohio.
- Ohio Coastal Training Program. 2008. *Training and Chagrin River Watershed Partners*. Available on Request from Old Woman Creek National Estuarine Research Reserve, 2514 Cleveland Road East Huron, Ohio.
- Ohio Lake Erie Commission. 2004. *Linking Land Use and Lake Erie: A Planning Framework for Achieving Balanced Growth in the Ohio Lake Erie Watershed*. From Ohio Lake Erie Commission Website.  
<http://www.dnr.state.oh.us/oleo/bg1/framework.html>
- Ohio Lake Erie Commission. 2008. *Lake Erie Protection and Restoration Plan*. From Ohio Lake Erie Commission Website:  
<http://lakeerie.ohio.gov/Portals/0/Reports/2008LEPRplan.pdf>

## APPENDIX A

### Training and Technical Assistance Offerings: 2004-2009 [Workshop Title — Key Partner Entity]

2004	Oil Spill Response in Freshwater Environments — NOAA Office of Response and Restoration
2004	Introduction to GIS — NOAA Coastal Services Center
2004	Coastal Applications of GIS — NOAA Coastal Services Center
2005	Lake Erie Ecology Seminar and Field Study
2005	Wetland Ecology Seminar and Field Study
2005	Coastal Ecology Field Study
2005	Sustainable Design and Public Use Facilities Roundtable
2005	Oil Spill Response in Freshwater Marshes and Streams – NOAA Office of Response and Restoration
2005	Effects and Control of the Invasive Reed, <i>Phragmites australis</i> in Lake Erie Coastal Wetlands
2005	Social Assessment in Coastal Regions – NOAA Coastal Services Center
2005	Land Protection Options: Public and Private Tools to Balance Conservation and Development — Firelands Land Conservancy
2005	Agricultural Land Preservation Program — Firelands Land Conservancy
2005	The Future of Ohio's Lake Erie Basin — Balancing Land Use and Water Quality — Ohio Sea Grant College Program
2006	Ohio Sea Grant State Legislature and Congressional Day on Lake Erie — Ohio Sea Grant College Program
2006	Grant writing for Community Based Watershed Planning (Technical Assistance)
2006	Grassroots Fundraising Training for Watershed Groups — Ohio Environmental Council
2006	Managing Stormwater in Your Watershed — Erie Soil and Water Conservation District
2007	Best Local Land Use Technical Sessions — Ohio Lake Erie Commission
2007	Wetland Conservation and Research Seminar — Ohio State University Watershed Extension
2007	Coastal Community Planning and Development – NOAA Coastal Services Center

- 2008 Coastal Community Planning and Development – NOAA Coastal Services Center
- 2008 Northeast Ohio Stormwater Conference – Tinkers Creek Watershed Partners
- 2009 Your New Municipal Stormwater Permit: What You Need to Know to Comply — Northeast Ohio Stormwater Training Council
- 2009 Ohio Stormwater Conference — Mill Creek Watershed Council of Communities, the Ohio Water Environment Association, Regional Storm Water Collaborative, and Tinkers Creek Watershed Partners
- 2009 Stormwater System Design and Performance – University of New Hampshire Stormwater Center and Northeast Ohio Stormwater Training Council
- 2009 Grant-writing for Environmental Improvements
- 2009 Renewable energy and local land use planning

## APPENDIX B

### Core Program Partner Descriptions and External Partners List

#### **Old Woman Creek National Estuarine Research Reserve**

Old Woman Creek National Estuarine Research Reserve is part of a national network of coastal reserves established as living laboratories for long-term scientific research and estuarine education. The Reserve was designated in 1980 and is managed as a cooperative partnership between the Ohio Department of Natural Resources (ODNR) and the National Oceanic and Atmospheric Administration (NOAA). Old Woman Creek is also dedicated as an Ohio State Nature Preserve.

Located in Huron, Ohio on the south-central shore of Lake Erie, Old Woman Creek is one of the state's few remaining examples of a natural estuary. As a transition zone between land and water, the site contains a variety of habitats including marshes and swamps, upland forests, open water, tributary streams, barrier beach and near shore Lake Erie. The estuary supports a diverse and important assemblage of native plants and animals. Freshwater estuaries are critical to the health of Lake Erie, serving as the lake's last line of defense by filtering out sediment and pollutants and protecting coastal communities by mitigating the impacts of storm runoff and flooding.

The 573-acre Reserve serves as a field laboratory where scientists can study naturally-functioning systems and where students and the general public can learn about estuarine ecology in a natural setting. Approximately 20,000 people visit the Reserve annually, participating in scheduled programs or exploring the site on their own. The Reserve's DeWine Center for Coastal Wetland Studies houses laboratories, classrooms, visitor exhibits, and administrative offices. A trail system is open for public use sunrise to sunset 365 days a year. Administration and on-site management of the Reserve supports long-term research and monitoring and provides education and training opportunities to encourage stewardship of the estuary and similar wetland ecosystems of the Lower Great Lakes.

#### **Department of Natural Resources, Division of Wildlife**

The Ohio Department of Natural Resources (ODNR), Division of Wildlife is the state agency responsible for management of Ohio's fish and wildlife resources and is the cooperating state agency for Old Woman Creek National Estuarine Research Reserve. It operates under a broad set of authorities found in the Ohio Revised Code. A portion of the Revised Code states that the Division of Wildlife holds title to all wild animals, which are not legally confined or held in private ownership, in trust for the benefit of all Ohioans. The Revised Code further directs the Division to plan, develop, and institute programs and policies that are designed for the general care, protection, and supervision of the wildlife resource in the state. The Division is also empowered to develop



and enforce regulations for the protection, preservation, propagation, management, and wise use of wild animals and specific plant(s). The primary source of funding for the Division comes from the sale of hunting and fishing licenses, federal excise taxes on hunting, fishing, and shooting equipment, and donations from the public. The Division of Wildlife's activities are carried out by a staff of approximately 460 professionally trained employees. This staff is comprised largely of fisheries and wildlife biologists, law enforcement officers, and various communications, education, information management, clerical, computer, and administrative management professionals. The Division also relies on many volunteers who assist in various projects, most notably hunter and trapper education.

### **Department of Natural Resources, Office of Coastal Management**

The Office of Coastal Management (OCM) is the lead agency in a cooperative effort by state agencies, political subdivisions and local groups to manage coastal resources, monitor activities that affect the resources, and foster the resources' sustainable use for the benefit of all citizens. The OCM program policy supports, recognizes, and reinforces the goals of the OWC NERR. For instance, the Reserve core area, the Old Woman Creek State Nature Preserve, is entirely within Ohio's designated coastal zone. The OWC NERR has a strong institutional relationship with OCM because of ODNR's interdisciplinary environmental reviews, nonpoint pollution management, coastal wetlands research and wetlands protection policies. Reserve staff assists the OCM with grant proposal review, project management and administration, and participates in the integrated management team structure of Ohio's coastal management program. An OCM staff serves as ex officio member of the Reserve Advisory Council and as a member of the Ohio CTP Executive Committee.

### **Ohio Sea Grant College Program, Ohio State University**

The Ohio Sea Grant College Program (OSGCP) is one of 32 Sea Grant programs in the National Sea Grant College Program of NOAA. Every coastal state and every Great Lakes state has a Sea Grant Program. Matching funds for Ohio's Sea Grant are through a line item in the budget of the Ohio Board of Regents, the Ohio State University, private businesses and individuals, and by the home institution of scientists receiving grants from Ohio Sea Grant. The Ohio State University extension system provides outreach support for the Program through affiliated agents that are regionally located across the Lake Erie coast. The Franz Theodore Stone Laboratory on Gibraltar Island near Put-in-Bay, the nation's oldest freshwater biological field station, serves as the research, education, and outreach facility for the OSGCP. The OSGCP has collaborated extensively with the Reserve in outreach activities such as Stone Laboratory summer session classes and through its commitment to the Ohio Coastal Training Program partnership. The Director of the Ohio Sea Grant College Program and Stone Laboratory serves as a voting member of the

OWC NERR Advisory Council and as a member of the Ohio CTP Executive Committee.

### **Ohio Lake Erie Commission**

The Ohio Lake Erie Commission is comprised of the directors of the Ohio Departments of Agriculture, Development, Health, Natural Resources and Transportation, as well as the Ohio Environmental Protection Agency. The mission of the Ohio Lake Erie Commission is to preserve Lake Erie's natural resources, protect the ecological quality of its watershed, and to promote economic development on the North Coast. This is accomplished through implementation of policies and programs of state government pertaining to such matters as water quality, habitat, recreation and tourism and resource management within the Lake Erie basin. These policies are implemented directly by the Ohio Lake Erie Commission and by its member state agencies. A significant role of the Commission is to ensure the coordination of policies and programs of state government pertaining to water quality, toxic substances, and coastal resource management. The Commission also oversees the Lake Erie Protection Fund which provides grants to public sector, academic and non-profit organizations for the protection and restoration of Lake Erie resources. Education and promotion of the importance of Lake Erie is the goal of the Commission public outreach activities. The Reserve supports the Commission's commitment to Lake Erie basin balanced growth watershed plans and collaborates with Lake Erie Commission on regional research and training as well as coastal resource stewardship projects. In 2008, the Lake Erie Commission became a core partner in the Ohio Coastal Training Program and designates a staff member to serve on the Ohio CTP Executive Committee.

**Additional Partners**

Chagrin River Watershed Partners, Inc.  
Cleveland State University, Maxine Goodman Levin College of Urban Affairs  
Cuyahoga County Board of Health  
Cuyahoga Soil & Water Conservation District  
Delaware County Engineer  
Erie Soil and Water Conservation District  
Erie County Solid Waste Management District  
Firelands Coastal Tributary Watershed Program  
Friends of Old Woman Creek  
GPD Associates  
Great Lakes Environmental Finance Center at Cleveland State University  
Mill Creek Watershed Council of Communities  
Natural Resources Conservation Service of U. S. Department of Agriculture  
NOAA Coastal Services Center  
NOAA Office of Response and Restoration  
Northeast Ohio Areawide Coordinating Agency  
Northeast Ohio Regional Sewer District  
ODNR Division of Soil and Water Conservation  
Ohio Environmental Protection Agency  
Ohio Nonpoint Education for Municipal Officials (NEMO)  
Ohio State University Extension  
Ohio Water Environment Association  
Regional Storm Water Collaborative  
Summit Soil & Water Conservation District  
The Countryside Program  
Tinkers Creek Watershed Partners  
U. S. Environmental Protection Agency

## APPENDIX C

### Stormwater Training Priorities of Local Government Officials and Stormwater Professionals

<b>How interested are you in training related to the following stormwater management practices or planning approaches?</b>					
	<b>Low</b>	<b>Moderate</b>	<b>High</b>	<b>% Mod. or High</b>	<b>Response Count</b>
Maintenance of practices & technologies	2	55	70	98.4	127
Performance of practices & technologies	4	54	70	96.9	128
Design of practices & technologies	6	55	67	95.3	128
Stormwater pollution prevention plan	9	42	78	93.0	129
Bioretention area	9	53	64	92.9	126
Rain garden	11	55	61	91.3	127
Stream restoration – natural channel design...	11	46	69	91.3	126
Watershed planning	12	54	63	90.7	129
Water quality pond	12	61	54	90.6	127
Soil stabilization – natural area preservation, seeding	12	67	47	90.5	126
Pollution prevention/good housekeeping	12	61	53	90.5	126
Urban stormwater retrofitting	12	49	63	90.3	124
Stormwater management ordinance	13	50	62	89.6	125
Permeable pavement	15	51	62	88.3	128
Phase II permitting and reporting	15	49	63	88.2	127
Sediment controls – sediment basins, silt fence	15	61	49	88.0	125
Infiltration trench	16	72	38	87.3	126
Constructed wetland	16	50	58	87.1	124
Clean Water Act 401/404 permitting	18	56	54	85.9	128
Permanent runoff controls – level spreader, outlet protection	18	52	54	85.5	124
Conservation development	19	63	44	84.9	126
Implementing stormwater utilities	19	49	58	84.9	126
Stream setback	19	64	40	84.6	123
Illicit discharge detection & elimination	20	51	57	84.4	128
Temporary runoff controls - rock check dam, slope drain	20	64	42	84.1	126
Buffer strip	20	63	41	83.9	124
Low impact development	21	60	48	83.7	129
Sand & organic filter	21	68	37	83.3	126

	<b>Low</b>	<b>Moderate</b>	<b>High</b>	<b>% Mod. or High</b>	<b>Response Count</b>
Stormwater financing	23	47	57	81.9	127
Wetland setback	24	59	42	80.8	125
LEED (green building) rating systems	25	68	35	80.5	128
Social marketing	26	66	36	79.7	128
Impacts of climate change	32	61	35	75.0	128
Green roof	36	57	37	72.3	130
Nutrient management	37	57	29	69.9	123
Septic system maintenance	53	46	26	57.6	125
Microbial source tracking	57	49	19	54.4	125
Conservation tillage	66	45	11	45.9	122

## APPENDIX D

### **Training Format and Logistic Preferences of Local Officials in Ohio's Lake Erie Watershed**

Excerpted from: *Training and Technical Assistance to Inform Land Use Planning and Protect Water Quality in Ohio's Lake Erie Watershed A Front-end Evaluation of Local Official Needs*. Ohio Coastal Training Program website:  
<http://www.dnr.state.oh.us/LinkClick.aspx?fileticket=Awl0HdrSdSg%3d&tabid=15316>

#### **Delivery Methods**

The internet was the most preferred method for information delivery, followed by printed publications, technical assistance, and newsletters. Formal training events such as workshops, field-based training, seminars, and round-tables ranked lower than information resources and technical assistance, especially among elected officials. Respondents rated distance learning formats such as web-based and video conference lowest among all training methods.

#### **Marketing and Logistics**

##### *Training Participation-Decision-Making Factors*

Relevance to professional field, time away from other responsibilities, adequate notice to plan for attendance and proximity to work or home rated as the most important factors in the decision to participate in training events. Cost and printed materials were moderately important in the decision to attend. For the majority of respondents, continuing education credit, accreditation by professional associations, and certificates were less important factors in their decision to participate. Credential-related factors were more significant in the decision to attend for administrative than they were for elected officials.

##### *Time Commitment*

One day and half day were the preferred time commitments for training events with evening and two-day events also appealing to a significant proportion of respondents. Weekends, and week-long trainings were the least desirable among the time commitment options surveyed.

##### *Marketing Preferences*

Postal announcement was the most preferred marketing method followed by e-mail notices and e-mail links to registration.

##### *Registration Preferences*

Mail and e-mail were the most preferred registration methods. Several respondents were interested in registering for training opportunities through their employers and a fair proportion were interested in web-based registration. Phone and fax were less preferred options.

*Training Locations*

The distribution of preferred training locations was relatively balanced, reflecting the broad geographic area represented by the respondent population. Appropriate locations for specific counties, watersheds, topics, or roles could be identified with more detailed analysis.

## APPENDIX E

### Ohio Coastal Training Program Executive Committee and Program Staff

#### Executive Committee Membership

Old Woman Creek National Estuarine Research Reserve  
Ohio Department of Natural Resources Division of Wildlife

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Program Administrator  
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**Old Woman Creek NERR  
Management Plan**

**APPENDIX K**

**Ohio CTP Needs Assessment**

## Ohio CTP Needs Assessment Summaries

### Decision-makers: Local Officials

#### Issue: Land Use Planning and Water Quality<sup>1</sup>

Ohio is a home rule state. Land use decisions are made at the local level by appointed and elected officials and administrative employees. Regional collaboration on land use decisions as promoted by the 2000 Lake Erie Protection and Restoration plan (and 2008 update) requires that community officials have access to scientific information related to land use and water quality, the technical knowledge necessary to minimize potential impacts on water resources through local plans and regulations, and that they understand the economic and fiscal benefits of natural resource stewardship. Prior studies (Kellogg, 2005 O'Brien, 2003) identified land use and water quality as key knowledge needs in the Lake Erie basin and local officials as a potentially underserved decision-maker group with respect to training and technical assistance in these topical areas.

In order to characterize the specific training and information needs of local officials in Ohio's Lake Erie watershed, the Ohio CTP conducted a front-end evaluation, or needs assessment. The study population consisted of a range of local government roles responsible for land use decisions (e.g. planning/zoning commissions, city councils, township trustees) or managing infrastructure that reduces or mitigates land use impacts on water quality (e.g. city/county engineers, public works directors, stormwater coordinators, water/wastewater superintendents) at the township, municipal, and county levels.

A survey was designed to gather local official perspectives on the issues and challenges they face related to land use and water quality, identify their training and technical assistance needs, assess their current state of knowledge and skill, and evaluate their preferences for delivery and marketing mechanisms. The survey was administered in both mail and web formats with a random sample of the population. Nearly 250 responses were received for all roles, watersheds, and counties within the target population for an overall response rate of 41%. Elected roles including city and village councils, township trustees, and zoning commissions responded in the largest numbers and comprised 80% of the respondent population for this survey. Results are summarized below:

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<sup>1</sup> Ohio Coastal Training Program (2008). *Training and Technical Assistance to Inform Land Use Planning and Protect Water Quality in Ohio's Lake Erie Watershed: A Front-End Evaluation of Local Official Needs.*

## **Decision-makers: Local<sup>2</sup> Government Officials**

### **Issue: Land Use Planning and Water Quality<sup>3</sup>**

#### **Knowledge/Skill Self-Assessment**

- Majority self-rated novice for range of issues related to land use and water quality
- Training participation very low

#### **Information Sources and Training Providers**

- Local agencies were most frequently accessed information source, followed by state and federal agencies. Peer reviewed journals and universities utilized least often.
- OEPA was most often utilized training provider, followed by SWCDs and ODNR

#### **Use of Data for Decision-Making**

- Demographic, land use, land cover data/maps utilized by > half of respondents
- Water quality data used least frequently
  - Most frequent reasons for non-use - Lack of, or unclear applicability to decision-making, inadequate access to data

#### **Highest Rated Training Topics (of 42)**

1. Funding sources
2. Stormwater management
3. Grant writing
4. Wastewater treatment
5. Source water protection
6. Renewable energy technology
7. Water pollution
8. Watershed management
9. Stream restoration
10. Sustainable design and construction

#### **Training Content Suggestions**

- Legal and environmental aspects of land use
- Water and wastewater regulatory changes
- Smart growth tools
- Land use planning
- Stormwater engineering and regulation compliance
- Expansion of programs that support sustainable rural development
- Communication skill development
- Performance data on stormwater practices and technologies
- Studies that quantify the economic value of natural resources

<sup>2</sup> Township, municipal, county – 247 survey responses (80% elected/appointed, 20% administrative/professional)

<sup>3</sup> Ohio Coastal Training Program (2008). *Training and Technical Assistance to Inform Land Use Planning and Protect Water Quality in Ohio's Lake Erie Watershed: A Front-End Evaluation of Local Official Needs.*

### Information Delivery Preferences

1. Internet
2. Printed publications
3. Technical assistance
4. Newsletters

### Factors in decision to attend

1. Relevance to professional field,
2. Time away from other responsibilities
3. Proximity to work or home

### Preferred time commitment

1. One day
2. Half-day

### Schedule preference

1. Elected/appointed officials – evening
2. Administrative staff - business day

### Marketing

1. Postal announcement
2. E-mail notices
3. Links to websites

### Registration

1. Mail
2. E-mail

### Trends and Conclusions

- Administrative staff indicated more interest in training than elected officials across all topics
- *Stormwater management* - highest-rated topic for 50% of roles, 2<sup>nd</sup> or 3<sup>rd</sup> for most others.
- Content suggestions:
  - Technical information on management practices and technologies
  - “How-to” manuals for meeting Phase II minimum control measures
  - Erosion control techniques
  - Flow charts to aid in enforcement
  - Funding sources, and community success stories
- Zoning commissions and administrative staff were very interested in training on topics corresponding to Lake Erie Balanced Growth Program’s BLLU Practices - stormwater management, stream and wetland restoration, and protection of source water, scenic resources, woodlands, and historic resources.

## Trends and Conclusions (continued)

- *Economic Value of Natural Resources* - Rated in top third of 42 training topics. Previous studies<sup>4</sup> have suggested decision-makers want training on quantifiable economic and fiscal benefits whereas providers tend to be more focused on scientific knowledge and that there are market gaps for training on economic/fiscal aspects of watershed stewardship. Taken together, these results indicate a potential role for Ohio CTP to work with partners to infuse information on the economic benefits of environmental stewardship into existing and new training curricula, and to inform regional research priorities.
- Although this study indicates a high degree of consistency across local government roles with regard to training needs; specific skill and knowledge needs may vary greatly by local government role and community.
- Respondents requested that training include information about funding sources, case studies, and trainers with practical experience in subject matter, state agency roles and contact directories.
- Local elected and appointed officials often serve in a volunteer capacity, and thus have constrained time to participate in training. When elected and appointed officials are the target audience, technical assistance and information resources should be prioritized over formal training events; and when events are held, they should be scheduled in the evening or be less than one day.
- Respondents were less interested in formal training events than technical assistance and information resources. Conferences and distance learning rated lowest among delivery methods.

### Priority Issue: Stormwater

- *Roles:* City/village engineer, stormwater coordinator, recycling coordinator, public service and public work director, county engineer, most elected roles
- *Challenges:* Funding for infrastructure; difficulty understanding, complying with, and enforcing NPDES Phase II regulations, managing impacts such as flooding, public education, 'balancing' economic development with environmental impacts, achieving cooperative approaches among communities and state agencies, access to accurate information
- *Training Needs:* Stormwater management, funding sources, grant writing, watershed management

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<sup>4</sup> Kellogg, 2002 and 2004

**Priority Issue: Economic Development**

- *Roles:* Economic development officer, city/village council member, county commissioner, land use planner, city/village manager
- *Challenges:* Funding, enforcement of local land use regulations, dealing with land use change, education, and attracting business
- *Training Needs:* Funding sources, stormwater management, grant writing, central business district redevelopment

**Priority Issue: Wastewater**

- *Roles:* Wastewater treatment superintendent, county health official, public works director city/village manager, economic development officer, and city village council member
- *Challenges:* Funding, compliance with regulation, updating infrastructure, education
- *Training Needs:* Funding sources, wastewater treatment, stormwater management, grant writing

**Priority Issue: Land Use Planning**

- *Roles:* Land use planner, city/village engineer, county commissioner, zoning commission, legal staff
- *Challenges:* Updating and enforcing zoning, balancing environmental protection with economic development, managing conflict, and addressing land use change, education of community and decision-makers
- *Training Needs:* Funding sources, stormwater management, grant writing

**Decision-makers: Coastal Community Officials**  
**Issue: Lake Erie Shore Erosion**

The LESEMP, an interagency workgroup led by the ODNR Office of Coastal Management, contacted the CTP coordinator in late 2006 for technical assistance with needs assessment. The coordinator led the workgroup through the on-line training, facilitated planning sessions, provided study design recommendations, and assembled a draft RFP for the project. Ohio Sea Grant College Program was contracted to conduct the study and the CTP Coordinator served as a member of the project team. Old Woman Creek NERR received \$5,000 of the project award.

The objective of this study was to gather information about local challenges, obstacles, training and technical assistance needs related to Lake Erie shore erosion to inform development of the Lake Erie Shore Erosion Management Plan and associated training for coastal property owners, local officials, and developers. Initially the team held three focus groups along the Ohio Lake Erie coast. Themes emerging from the focus groups were used to develop surveys for coastal property owners and public officials. Surveys were administered with representative random samples of both populations and the report is currently in preparation.

Over 56% of responding public officials were interested in training or technical assistance to assist them in decisions and projects to manage Lake Erie shore erosion.

Specific technical knowledge or skill needs:

- Information about plans and permits
- Financing
- Best management practices
- Understanding Lake Erie shore erosion
- Assistance selecting qualified engineers and contractors



**Decision-makers: Local officials and private sector**  
**Issue: Stormwater management<sup>5</sup>**

**Top 15 Topics for Additional Stormwater Training**

1. Maintenance of practices & technologies
2. Performance of practices & technologies
3. Design of practices & technologies
4. Stormwater Pollution Prevention Plan (SWPPP)
5. Bioretention
6. Watershed planning
7. Rain garden
8. Stream restoration
9. Water quality pond
10. Soil stabilization – natural area preservation, seeding
11. Pollution prevention/good housekeeping
12. Permeable pavement
13. Urban stormwater retrofitting
14. Stormwater management ordinance
15. Phase II permitting and reporting

**Suggested Topics for Future Stormwater Conferences**

- Grant-writing for small communities
- Research by the region's university faculty on stormwater related issues.
- Native plants
- Seeding and seed establishment
- Stormwater mapping and data management.
- Watershed delineation mapping and modeling
- Keep the training hands-on, fundamental "here's how you do this" type session.
- Strategies/success stories for fostering policy changes on zoning, land use, SWM, etc in local government.
- Surface/subsurface hydrology of development that drains to a wetland (required in new CGP)
- Performance of manufactured stormwater treatment devices (sumps, filters, hydrodynamic separators, etc.); by experienced testing entity/professional (e.g., NJCAT)
- Measuring BMP performance using USEPA BMP database methodology
- Biophilia
- Stormwater management in cold region states
- Smart growth case studies from across the country
- Case study of stormwater practices and/or retrofit for individual residences
- Information from EPA regarding regulatory policy and past enforcement issues
- Emergency response
- Updates on NEORSD stormwater program

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<sup>5</sup> Northeast Ohio Stormwater Conference evaluation and needs assessment results

### **Suggested Topics for Future Stormwater Conferences**

- Microbial monitoring methods
- Local watershed partners and non-profit programs
- Stormwater facility maintenance.
- Collaboration among agencies

### **Top 10 Technical Sessions <sup>6</sup>**

1. Stormwater financing
2. Using stormwater retrofits to mitigate impacts from uncontrolled runoff
3. Best practices in stormwater education roundtable
4. Performance evaluations for a range of stormwater LID, conventional structure, and manufactured treatment devices in a cold climate – UNH Stormwater Center
5. Promoting better stormwater management through innovative watershed modeling
6. Implementing stormwater utilities
7. The use and abuse of the curve number method
8. Implementation of ecologically sound stormwater management
9. Intricacies of a watershed plan – modeling, planning, and restoration
10. Developing stormwater permit links to implement the Potash Brook TMDL

### **Decision-makers: Local government and private sector**

#### **Issue: Land use planning, balanced growth<sup>7</sup>**

### **Participant suggestions for content, format, and materials**

- Interactive format– e.g. discussion, problem-solving, networking<sup>8</sup>
- Technical training for specific audiences - e.g. developers, engineers, zoning/planning depts.
- Enhance facilities and technology
- Local case studies of BMP implementation
- Economic benefits of BMP implementation
- Stormwater management
- Public involvement
- Matrix of model regulations
- Bibliography of BMP performance research
- Agency contact information

### **Suggested target audiences**

- Homebuilders
- Developers
- Planning Commissions
- Board of Zoning Appeals
- Engineers

<sup>6</sup>Participant reported increases in understanding and intent to apply new knowledge and perspectives

<sup>7</sup> Results of program and session evaluation survey, including mini-needs assessment

<sup>8</sup> Consistent with Kellogg (2002) - decision-makers prefer interactive, discursive training methods to lecture-style formats.

**Old Woman Creek NERR  
Management Plan**

**APPENDIX L**

**Resource protection policies and statutes for  
OWC NERR**

## Appendix L: Resource Protection Policies and statutory authority for OWC NERR

TOPIC	ODNR/Div. of Wildlife/State Nature Preserve Policies	SOURCE
<b>Habitat Management Restoration Manipulation</b>	Provide habitat management and restoration including fire management, successional mowing, boundary and fence row maintenance, <u>small</u> scale manipulation; and application of selected herbicides and pesticides for control of invasive and exotic species carried out by trained and certified staff.	<b>ODNR, Division of Wildlife</b> ORC 1531.04, 1531.06
<b>Pollutant Spill Response</b>	Provide guidance for reporting a spill; support information for local fire and law enforcement personnel, professional first response teams, government on-scene coordinators, and other advisory agencies.	Berlin Township Fire Department (First responder) The Ohio and the Erie County Emergency Management Agencies, working with the National Response Center are responsible for coordination of other local and state emergency plans.
<b>Wetlands and Water</b>	Protect, preserve and manage wetlands through the enforcement of Ohio Water Quality Standards for any activity which may result in any discharge into wetlands and other waters of the State; acquire wetlands or interest in wetlands and associated buffer lands; and provide leadership and actions to minimize adverse effects to wetlands.	<b>Ohio/ODNR/Wildlife/OWC</b> ORC 1531.04 ORC Chapter 6111.03 OAC Chapter 3745 Section 401 of River and Harbors Act of 1899 Governor's Executive Order 90-68 U.S. Army Corps of Engineers, Section 404
<b>Wildlife</b>	Protect all wildlife including nongame and endangered species.	<b>ODNR, Division of Wildlife</b> ORC Chapter 1531, 1533
<b>Exotic Species</b>	Prevent introduction of and control exotic species in order to preserve the balance and diversity of natural ecosystems in Ohio's Lake Erie Region by: regulating sale and propagation of purple loosestrife; regulating importation, sale and possession for purposes of introduction into waterways of exotic species of fish or hybrids thereof.	<b>ODNR</b> ORC Chapter 927.682 OAC Chapter 1501.31-19-01
<b>Rare and Endangered Species and Species of Special Concern</b>	Preserve/protect rare, threatened and endangered plant/animal species by restricting the taking or possession of native plant and animal species threatened with statewide extinction; restricting the taking, possession, removal, transport or sale of native plant species listed as endangered/threatened with extirpation; protect the waters which provide habitat for rare and endangered species. Protect fish and wildlife species threatened with statewide extinction; protect waters of exceptional ecological significance; protect aquatic species identified as threatened or endangered.	<b>ODNR-Division of Wildlife (ODW)</b> ORC. Chapters 1531.25 and 1531.99 <b>ODNR, Division of Natural Areas and Preserves (DNAP)</b> ORC Chapter 1518.03 <b>Ohio EPA</b> Anti-degradation Policy OAC Chapter 3745-1-05 and O.R.C. Chapter 6111.03
<b>Air</b>	Attain and maintain air quality levels that protect public health and prevent injury to plant and animal life by surveying and monitoring air quality, enforcing national air quality standards and restricting open burning.	<b>EPA</b> ORC Chapters 3745, 3706, 5709

**Appendix L: Resource Protection Policies and statutory authority for OWC NERR – con't.**

TOPIC	ODNR/Div. of Wildlife/State Nature Preserve Policies	REFERENCES/SOURCE
<b>Hazardous, Solid and Infectious Waste</b>	Regulate the generation, transportation, treatment, storage and disposal of hazardous wastes.	<b>Ohio EPA</b> OAC Chapter 3734
<b>Visual and Aesthetic Quality</b>	Prohibit the dumping of such items as litter, garbage, rubbish, cans, bottles, paper, cartons, glass, automobile parts, furniture, and refuse into or along the waters of Lake Erie and its tributaries and maintain law enforcement activities to apprehend violators; and enforce state and water quality standards.	<b>STATE OF OHIO</b> ORC Chapters 1531.29 and 3767.32 ORC Chapter 6111 and O.A.C. Chapter 3745-1-04
<b>Historic Preservation</b>	Protect cultural resources on all properties owned and managed by ODNR. Preserve historic sites and recovery of scientific information from such sites.	<b>ODNR</b> Cooperation with <b>Ohio Historical Society</b> and Ohio Historic Site Preservation Advisory Board. ORC Chapter 149.53 National Historic Preservation Act of 1966
<b>Coastal Management</b>	Write OCMP policies about shoreline and coastal portion of OWC NERR and incorporate Reserve boundaries within federally-approved coastal zone.	State of Ohio Coastal Management Program

**Old Woman Creek NERR  
Management Plan**

**APPENDIX M**

**Floodplain restoration plan, Darrow Road**

**Existing Conditions:**

Size - 5.6 ac.

Vegetation - The site was surveyed on 5-9-08 (see attached figure). Prior to being treated with herbicide in 2007, the site was covered with a near monoculture of reed canary grass, and approximately 0.7 ac of the site consists of low density patches of willow, ash, silver maple, box elder, and cottonwood which have an understory of reed canary grass. Approximately 3.7 ac of reed canary grass were treated with herbicide in 2007. Approximately 1.9 ac of reed canary were not sprayed due to equipment damage caused by the rough terrain. During the 5-9-08 survey, heavy germination of an unidentified grass (suspect reed canary grass) and scattered patches of Canada thistle were noted in the sprayed areas.

There are approximately 4.9 ac. suitable for reforestation, assuming the overstory of tree patches 1 and 2 (see attached figure) are open enough to allow successful planting underneath. Otherwise there are approximately 4.4 ac. available.

Soils - soils are primarily Holly silt loam characterized by occasional flooding and poor drainage. Flooding of the site is greatly influenced by the fluctuating water levels of Lake Erie, the status of the beach ridge at the mouth of Old Woman Creek (open vs. closed), and storm events within the watershed. Flooding is better characterized as periodic and seasonal.

**Management Recommendations:**

It would be advisable to re-spray as much as possible of the entire 5.6 ac in 2008 to reduce competition from reed canary grass (especially the 1.8 ac of untreated reed canary grass), and to control Canada thistle. Thistle may concern neighboring farmers and become a weed problem on site.





Recommended tree species for reforestation are swamp white oak, pin oak, green ash, and silver maple, although green ash may not be advisable given the threat of emerald ash borer. According to USDA/NRCS tree planting recommendations, black walnut is not recommended for planting due to the poor drainage and frequent flooding of the site.

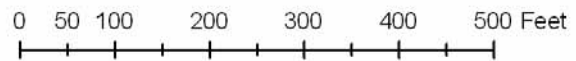
Bare root seedlings should be planted after ground thaw and prior to May 15<sup>th</sup>. Tree planting recommendations from the USDA/NRCS are 8-15 feet within/between rows. However, it was suggested by an environmental restoration consultant (pers. comm., Mal Gilbert) to plant ¼ to ½ ac single-species patches of densely spaced seedlings (6-8 foot spacing) to reduce competition and shading of the slower growing oaks which may also help prevent deer damage to trees in the patch centers. In particular, faster growing silver maples and green ash should be planted in single-species patches. Tree guards should be used on a minimum of 50% of the seedlings (oaks in particular) to enhance their chances of survival. Quantity of trees per acre based on 6'x6' spacing is 1,210 seedlings per acre, and 681 seedlings per acre at an 8'x8' spacing. Using a rounded figure of 4.5 acres suitable for reforestation, the number of seedlings needed ranges from 5,700 seedlings (6x6 spacing) to 3200 seedlings (8x8 spacing).

It is also recommended to plant 20-30 saplings (6-8' tall) of swamp white and pin oaks, and to plant random oak patches by direct seeding of acorns.



**Legend**

-  Boundary of reforestation area
-  Reed-canary grass (untreated)
-  Tree patches (existing)
-  Old Woman Creek Preserve Boundary





**Old Woman Creek NERR  
Management Plan**

**APPENDIX N**

**Memorandum of Understanding, Divisions of  
Wildlife and Nature Preserves regarding  
administrative transfer of OWC NERR**

**MEMORANDUM OF UNDERSTANDING**  
**Between**  
**DIVISION OF NATURAL AREAS and PRESERVES**  
**And**  
**DIVISION OF WILDLIFE**  
**Regarding**  
**OLD WOMAN CREEK STATE NATURE PRESERVE**

This Memorandum of Understanding ("MOU") is entered into by and between the Division of Natural Areas and Preserves ("DNAP") and the Division of Wildlife ("DOW") within the Ohio Department of Natural Resources ("ODNR") effective October 3, 2004. The parties intend to transfer from DNAP to DOW administration of Old Woman Creek State Nature Preserve ("OWCSNP"), as well as the program known as Old Woman Creek National Estuarine Research Reserve ("OCWNERR"), along with all existing rights and duties in relation to OWCNERR. This MOU is intended to describe the disposition of assets and responsibilities resulting from this transfer.

WHEREAS ODNR owns certain real property in Erie county that has been dedicated under R.C. Chapter 1517 as a state nature preserve known as OWCSNP; and

WHEREAS DNAP administers OWCSNP and also manages a program known as OWCNERR under grant from the National Oceanic and Atmospheric Administration ("NOAA") of the United States Department of the Commerce ("DOC") at the OWCSNP; and

WHEREAS DNAP and DOW desire to transfer administrative control and management responsibility for OWCSNP and OWCNERR from DNAP to DOW;

NOW, THEREFORE, the parties agree to the terms and conditions that follow.

A. OWCSNP

1. ARTICLES OF DEDICATION

The parties acknowledge that all of the OWCSNP is subject to Articles of Dedication that govern use of the property. A copy of the Articles of Dedication as amended is attached hereto as Appendix A. DOW agrees to manage and maintain OWCSNP in accordance with the Articles of Dedication and Chapter 1517 of the Revised Code.

2. DESCRIPTION OF THE PREMISES

The premises at OWCSNP are illustrated in Appendix B, an aerial photograph attached hereto. The premises includes all buildings, facilities and fixtures on OWCSNP property. The entire premises shall transfer from DNAP to DOW on October 3, 2004. The ODNR inventory shall reflect this transfer. An area within the premises that consists

of a pole barn (the "pole barn") and convenient access to same is shown on Appendix B. Use of the pole barn and access shall be available at no cost to DNAP. The pole barn shall be available for DNAP use until such time as the Chief of DNAP determines that use of the pole barn is not needed or desired by DNAP. DNAP will be responsible for routine maintenance and repair. This MOU does not require either party to rebuild or perform major repairs. In the event major repairs are needed, the parties will discuss whether major repairs should be performed and how the cost of such and future use of the pole barn should be allocated.

A federal appropriation has been received for acquisition of additional lands at OWCSNP. Paperwork has been filed with NOAA and the grant is in effect for two years ending June 30, 2006. Under the agreement land is to be purchased in the Old Woman Creek watershed from willing sellers. The parties agree that the property acquired shall be dedicated as and become a part of OCWSNP under the terms and conditions contained in the Articles of Dedication as amended and attached hereto as Appendix A consistent with Chapter 1517 of the Ohio Revised Code. A majority of the funds for the State match for the acquisition in an amount not to exceed \$300,000 are available in the Columbus Foundation OWC Fund (#972) and shall be preserved for such use by DOW. The remaining match not to exceed \$97,000 will be the responsibility of DOW.

### 3. EQUIPMENT

An inventory of the equipment at OWCSNP was conducted on August 26-27, 2004. A copy of the inventory is attached hereto as Appendix C. The parties agree that all items listed in this inventory, unless otherwise noted, shall transfer from DNAP to DOW effective October 3, 2004. Use or disposition of such inventory shall be governed by all Ohio statutes and rules as well as all statutes, rules or grant conditions imposed by the source of funds with which the inventory items were acquired. DNAP agrees to provide DOW with adequate information to enable DOW to readily determine any applicable limitation or restriction on use or disposition of the inventory. ODNR records shall reflect the transfer of the inventory effective October 3, 2004.

### B. INCOMING GRANTS

A list of all sources of incoming grants coming to DNAP for OWCNERR is included at Appendix D. On or before October 3, 2004, DNAP shall give DOW a summary of grant fund income and status for OWCNERR.

The parties understand that the OWCNERR program is administered in accordance with grants and the Memorandum of Understanding between ODNR and NOAA, which is attached as Appendix E. DOW shall administer the OWCNERR program consistent with obligations undertaken in the OWCNERR grant agreements, MOUs and any other applicable agreements from NOAA or other appropriate agency. DOW agrees to comply with all source of income requirements, by contract or code, in the acceptance, accounting and spending of funds. DNAP will provide information requested by DOW to enable it to comply timely with the requirements of all grants or other sources of funds.

C. OUTGOING FUNDS

DNAP is under contract with various entities that are providing personal services or performing other functions to benefit the OWCNERR program. A list of all such outstanding contracts, including but not limited to grants and personal service agreements, is attached as Appendix F. Appendix F also includes a brief description of each contract, stating scope of service, funding sources and amounts, and projected end date. The parties intend that all such contracts will be unaffected by the transfer of responsibilities from DNAP to DOW. The parties agree that such contracts shall transfer from DNAP to DOW on October 3, 2004. DNAP shall be available to provide DOW with any supporting documentation or information to assist DOW in administering such contracts.

D. TRANSFER OF EXISTING FUNDS

Responsibility for any unexpended grant money that DNAP obtained for the OWCNERR program shall transfer from DNAP to DOW on October 3, 2004.

E. EMPLOYEES

Appendix G to this MOU is a list of Position Control Numbers ("PCNs") for all positions at OWCSNP. On the effective date of this agreement, DOW shall assume administrative control of and responsibility for such positions. The parties agree that in the event any person who is an incumbent of any listed PCN on the effective date of this MOU opts to take the pending ODNR early retirement incentive, DNAP shall bear the full cost of the employer for the purposes of purchasing service credit on behalf of any such employee.

F. EFFECTIVE DATES

This MOU shall take effect October 3, 2004, and remain in effect unless rescinded or amended in writing by both signatories or their successors, upon written approval of the Director of ODNR.

ODNR, Division of Wildlife

By: Steve G. Gray

Title: \_\_\_\_\_

Date: 10-29-2004

ODNR, Division of Natural Areas  
and Preserves

By: Donna Stoyar

Title Acting Chief

Date 11-1-2004

Concurrence with Memorandum of Agreement  
ODNR, Director

By: Glen Oberlander

Title: 11/4/04

Date: Asst Director

APPENDIX A – Articles of Dedication as Amended (through August 1, 2004; 43 pages)

APPENDIX B – aerial photos showing premises (pole barn and access to be marked) (2 pages)

APPENDIX C – inventory (17 pages)

APPENDIX D – list of grants to DNAP (1 page)

APPENDIX E – MOU with NOAA (5 pages)

APPENDIX F - list of grants from DNAP and personal service agreements, utility contracts, etc. (1 page)

APPENDIX F – list of employees at OWCNERR (1 page)

**Old Woman Creek NERR  
Management Plan**

**APPENDIX O**

**Transfer of management responsibility for OWC  
State Nature Preserve**

**JOURNAL ENTRY  
DIVISION TRANSFER**

381

**Division Transfer of Land  
Division of Natural Areas and Preserves to  
Division of Wildlife for  
Old Woman Creek State Nature Preserve**

**April 22, 2005**

**WHEREAS**, pursuant to Section 1501.01 of the Revised Code, the Director of Natural Resources shall correlate and coordinate the work and activities of the divisions in the Department of Natural Resources; and

**WHEREAS**, The Division of Natural Areas and Preserves, Ohio Department of Natural Resources, does hereby transfer and release to the Division of Wildlife, Ohio Department of Natural Resources, its jurisdiction and control of Old Woman Creek State Nature Preserve containing ±573.03 acres. Said property described as being: situated in the State of Ohio, County of Erie, and the Townships of Huron and Annexation to Berlin. Being parts of Lots 12, 13, 14, 15 and 16 of Township 6 North, Range 20 West Berlin Annexation and being parts of Lots 13, 14 and 24 of Township 6 North, Range 22 west and being lands conveyed to the State of Ohio, Department of Natural Resources as further described in the attached Exhibit A; and

**WHEREAS**, the parties acknowledge that all of the Old Woman Creek State Nature Preserve is subject to Articles of Dedication that govern use of the property as set forth in the signed Memorandum of Understanding between the Division of Natural Areas and Preserves and the Division of Wildlife, Appendix A. The Division of Wildlife agrees to manage and maintain Old Woman Creek State Nature Preserve in accordance with the Articles of Dedication and Chapter 1517 of the Revised Code.

**WHEREAS**, the Director of the Ohio Department of Natural Resources, State of Ohio, has deemed the above transfer of jurisdiction and control to be beneficial to the citizens of the State of Ohio; and

**NOW THEREFORE**, this jurisdictional transfer of land is agreed to by the Division of Natural Areas and Preserves and Division of Wildlife and have caused their names to be subscribed by their respective Chiefs and further approved by the Director of Natural Resources.

5-10-2005  
Date

5-5-2005  
Date

5-23-05  
Date

Thomas E. Linkous  
Tom Linkous, Chief  
Division of Natural Areas & Preserves

Steven A. Gray  
Steven A. Gray, Chief  
Division of Wildlife

APPROVED:  
Samuel W. Speck, Jr.  
SAMUEL W. SPECK, Director  
Ohio Department of Natural Resources

EXHIBIT "A"  
Legal Description Old Woman Creek

Situated in the State of Ohio, County of Erie, and the Townships Huron and Annexation to Berlin. Being parts of Lots 12, 13, 14, 15 and 16 of Township 6 North, Range 20 West Berlin Annexation and being parts of Lots 13, 14 and 24 of Township 6 North, Range 22 west and being lands conveyed to the State of Ohio, Department of Natural Resources by the following instruments:

Instrument Number	Date of Conveyance	Grantor	Assessed @ Purchase	Deed Acreage	Auditor Parcel Number(s)
464/198	11/29/1977	Margaret Ann Murray, et ux	\$32,400	10.652	05-61001.000
493/1069	11/23/1981	Margaret Ann Murray, et ux	\$ 0	0	05-61001.000 (Combined w/above parcel)
471/578	10/5/1978	Lester W. Hoffman, et al	\$ 720	13.42	01-61002.000 & 01-61001.000
471/771	10/12/1978	William H. Williams, Trustee for Edward Walper, et al	\$27,120	137.32	01-61011.000
497/98	5/7/1982	Edward Walper Life Estate	\$ 320	1.62	01-61011.000
472/781	11/20/1978	Fred L. Willgrube, et ux	\$10,000	37.751	01-61005.000 & 39-61012.000
472/778	11/20/1978	William F. Kaiser, et al	\$ 1,890	11.243	39-61013.000
474/377	1/31/1979	Beth K. Stocker, Executrix	\$ 2,570	18.79	01-61010.000
474/375	1/31/1979	Wayne E. Jenkins, et ux	\$ 1,760	50.206	01-61003.000
475/44,48 & 52	2/20/1979	Anderson Acres, Inc. et al	\$34,120	191.01	39-61025.00, 01-61036.000 & 01-61009.000
478/678	7/20/1979	Gladys L. Phillips, et al	\$17,380	17.384	01-01046.000
479/792	9/19/1979	Clifford Long, et ux	\$ 3,350	4.949	01-61006.000
481/461	9/2/1979	Oberlin Beach Association	\$ 5,580	38.351	01-61008.000
483/5	3/6/1980	Lawrence A. Schuh, et ux	\$21,350	17.684	01-61004.000
488/883 & 886	11/18/1980	Charles B. Hartley, et al	\$ 3,950	12.942	01-61013.000
489/732	2/10/1981	Ronald H. Fix, et al	\$ 90		0.104 (no parcel number combined with 01-61003.000
540/290	12/31/1987	Charles B. Hartley, et al	\$ 6,450	4.2899	Part of 01-61012.000
540/297 & 551/137	12/31/1987	Charles B. Hartley, et al	\$35,881	4.7231	05-61003.000 & Part of 01-61012.000
RN200319929	9/16/2003	Ronald H. Fix, et ux	\$ 9,720	2.23	01-01227.000

Also the following easements

488/888	11/18/1980	Charles B. Hartley, et al	\$ 680	2.9114	N/A
RN200111994	8/15/2001	Huron Green LLC	\$ 2,005	0.571	N/A



**Old Woman Creek NERR  
Management Plan**

**APPENDIX P**

**OWC NERR Advisory Council By-laws, as  
amended, May 2005**

**OLD WOMAN CREEK NATIONAL ESTUARINE RESEARCH RESERVE  
ADVISORY COUNCIL BY-LAWS**

**ARTICLE I – NAME AND PURPOSE**

**Section 101 – Name**

The name of the group shall be the “Old Woman Creek National Estuarine Research Reserve Advisory Council.” It shall also be known as the “Advisory Council.”

**Section 102 – Purpose**

The Advisory Council shall advise the Chief of the Division of Wildlife on the administration and management of Old Woman Creek (OWC) as a National Estuarine Research Reserve (NERR), hereinafter referred to as “OWC NERR” or “Reserve.”

**Section 103 – Duties**

The Advisory Council shall:

- A. Review and make recommendations on policies and plans for the use, management, conservation, and stewardship of lands and waters associated with OWC NERR;
- B. Review and make recommendations on the development of facilities and improvements within the Reserve that are necessary for its visitation, use, restoration, management and conservation, and which do not detract from its natural character;
- C. Advise the Division of Wildlife regarding the development and implementation of interpretive and educational programs at OWC NERR;
- D. Advise the Division of Wildlife regarding the publication and dissemination of interpretive brochures, educational materials, and other information about the Reserve and its core programs;
- E. Review and make recommendations on research priorities for OWC NERR that are consistent with the management plan for the Reserve as well as the mission of the Division of Wildlife and its strategic plan;
- F. Assist the Division of Wildlife in the review of proposals for research projects, surveys, and species inventories within the Reserve;
- G. Advise the Division of Wildlife on sources and methods of securing external funds to support scientific endeavors at OWC NERR;
- H. Advise and consult with the Chief and other Division of Wildlife employees assigned to OWC NERR on other matters pertaining to the good and welfare of the Reserve.

### Section 104 – Legal Authority & Liability

The Advisory Council has no legal authority to put its recommendations into action nor does it have any liability that may result from consequences of actions taken by the Division of Wildlife or the OWC NERR program.

## **ARTICLE II – MEMBERSHIP**

### Section 201 – Membership, Term of Office

The Advisory Council shall consist of at least nine (9) members appointed by the Director of the Ohio Department of Natural Resources. The Advisory Council shall be composed of at least one (1) member each from a local government agency, a local conservation group, an Ohio or national conservation group, a local agricultural institution, a local civic group, a local or regional economic development group, an Ohio educational institution, a Great Lakes research institution, and a local landowner. The Chief of the Division of Wildlife (or their designee), the Reserve administrator, and research, education, and stewardship coordinators of OWC NERR shall be ex-officio members of the Council, with a voice in its deliberations, but without the power to vote. The Advisory Council may designate additional ex-officio members, as deemed necessary.

The Advisory Council members shall be appointed to staggered three (3) year terms and may be reappointed to consecutive terms. The Advisory Council members shall serve without remuneration.

### Section 202 – Resignation

Any member of the Advisory Council may resign his or her appointment at any time by written notice to the Director of the Ohio Department of Natural Resources. The Director shall appoint a replacement to serve out the unexpired term of said member.

### Section 203 – Removal of Appointment

If a member of the Advisory Council misses three (3) consecutive meetings without explanation, a letter will be sent to him or her by the Secretary, inquiring as to his or her continued interest in serving on the Advisory Council. If there is no response to this inquiry, and the member misses one (1) additional meeting without explanation, the Advisory Council may, by a majority vote, request the Director of the Department of Natural Resources to secure his or her resignation.

## **ARTICLE III – OFFICERS, COMMITTEES**

### Section 301 – Officers, General

The Advisory Council shall annually elect a Chairman, Vice-Chairman, and a Secretary from its members. Nominations shall be presented and recorded by the general membership and votes shall be presented, recorded, and cast by the general membership in a manner previously agreed upon by the Advisory Council. Unless otherwise specified, a simple majority vote shall indicate the selection of the appropriate officer. The term of office shall run for a period of one (1) year from the date of installation of officers, and shall terminate with the election and installation of new officers. Officers are not limited in the number of terms that they may serve on the Advisory Council.

Section 302 – Vacancies, Manner of Filling

In the event an officer shall be unable to carry out the duties or responsibilities of his/her office, or in the event the office shall become vacant, the Advisory Council may call a special election to determine a replacement for that office for the remainder of its annual term. The procedure for such special election shall be similar to selection of officers as stated under Section 301.

Section 303 – Duties of the Chairman

The Chairman shall preside at all meetings of the Advisory Council. He/she can be a member of any committee, and, except to the extent otherwise provided, shall perform all the duties incident to the office, and such other and further duties as may from time to time be required or requested of him/her by the Advisory Council.

The agenda for Advisory Council meetings will be established by the Chairman, in consultation with the Reserve Administrator, at least two (2) weeks before the scheduled date of the meeting. Members may submit topics for inclusion in the meeting agenda to the Secretary at least three (3) weeks before a scheduled meeting.

Section 304 – Duties of the Vice-Chairman

The Vice-Chairman shall perform all the duties of the Chairman in the case of his/her absence, and such other and further duties as may from time to time be required or requested by the Advisory Council. In the event that both the Chairman and the Vice-Chairman are absent or unable to perform their duties, the Advisory Council shall appoint a Chairman Pro Tempore.

Section 305 – Duties of the Secretary

The Secretary shall keep or supervise the keeping of the minutes of all meetings of the Advisory Council and shall perform such other and further duties as may be required or requested of him/her by the Advisory Council.

Section 306 – Committees

Committees of the Advisory Council may be formed to undertake particular studies, consultations, or informational efforts. Standing Committees may be formed at the discretion of the Chairman, with the approval of the Advisory Council, and shall report to the membership of the Advisory Council. Standing Committees shall only include members of the Advisory Council. All Special Committees may be appointed by the Chairman upon approval of the Advisory Council and shall report to the membership of the Advisory Council. Special Committees may include persons who are not members of the Advisory Council.

**ARTICLE IV – MEETINGS, QUORUM, VOTING, AMENDMENTS**Section 401 – Quarterly Meetings

The Advisory Council shall hold at least four (4) quarterly meetings in each calendar year. Regular meetings are to be conducted according to generally accepted parliamentary procedures. The Advisory Council shall meet at the Reserve unless otherwise agreed to by the members.

Section 402 – Special Meetings

Special meetings may be called by the Chairman or by petition of any three (3) members to the Chairman.

Section 403 – Manner of Notification

The Reserve Administrator shall give notice of each quarterly or special meeting to each member of the Advisory Council at least (10) days prior to such meeting except in an emergency. Notice of any special meeting shall include a statement as to the purpose of said meeting.

Section 404 – Quorum

A quorum shall consist of a majority of all voting members of the Advisory Council.

Section 405 – Manner of Voting

The actual manner of voting on an issue may be determined by the Advisory Council. Normally, a roll call vote or a show of hands shall be the method to determine the outcome of an issue. All abstaining votes shall be noted in the minutes of the proceedings.

Section 406 – Amendment

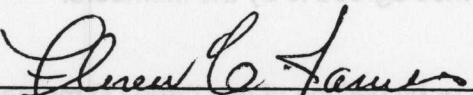
These By-Laws may be amended as deemed necessary and expedient by the membership of the Advisory Council. The following procedure shall be used to amend these By-Laws:

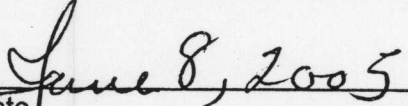
1. Proposed amendments may be made by any member of the Advisory Council and distributed to all other members at least two (2) weeks prior to the next quarterly or special meeting designated for discussion.
2. At the next quarterly or special meeting, the proposed amendment shall be discussed and presented for adoption per generally accepted parliamentary procedures. Such proposed amendment shall be deemed adopted upon receiving the affirmative vote of a two-thirds (2/3) majority of all voting members of the Advisory Council.
3. The Chief of the Division of Wildlife will review all amendments to the By-Laws, and will either approve said amendments or provide written comments to the Advisory Council at their next quarterly meeting. Approval of any proposed amendment by the Chief of the Division of Wildlife is required before such amendments are formally accepted as part of the By-Laws.

Section 407 – Inclusion of Other Statutes

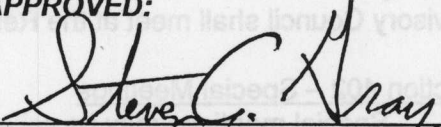
Should any section or provision of these By-laws be declared unconstitutional or invalid by a Court of Law, such decision shall not affect the validity of the remainder of the By-Laws as a whole, or any part thereof, other than the part so declared to be unconstitutional or invalid.

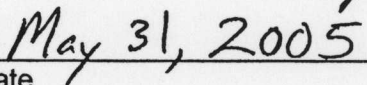
**ADOPTED:**

  
 \_\_\_\_\_  
 Chairman, OWC NERR Advisory Council

  
 \_\_\_\_\_  
 Date

**APPROVED:**

  
 \_\_\_\_\_  
 Chief, Division of Wildlife

  
 \_\_\_\_\_  
 Date

OWC NERR Management Plan, 2011 - 2016

**Old Woman Creek NERR  
Management Plan**

**APPENDIX Q**

**Final Evaluation Findings for the State of Ohio's  
Old Woman Creek National Estuarine Research  
Reserve, September 2006 through October 2009,  
Executive Summary**



UNITED STATES DEPARTMENT OF COMMERCE  
National Oceanic and Atmospheric Administration  
NATIONAL OCEAN SERVICE 389  
OFFICE OF OCEAN AND COASTAL RESOURCE MANAGEMENT  
Silver Spring, Maryland 20910

Sean Logan, Director  
Ohio Department of Natural Resources  
2045 Morse Road, Building D-3  
Columbus, Ohio 43229-6693

JUN 11 2010

Dear Mr. Logan:

Enclosed are the final evaluation findings for the Old Woman Creek National Estuarine Research Reserve (Reserve) for the period from September 2006 through October 2009.

The fundamental conclusion of this evaluation is that Ohio is adhering to the programmatic requirements of the NERR system in its operation of the approved Old Woman Creek Reserve. This document contains four recommendations, three of which are mandatory. In response to the State's comments on the NOAA draft evaluation findings and information about activities that have occurred since the site visit, we have included additional comments and information in the findings. Based on the information you provided about the Reserve's Advisory Council membership and bylaws as well as the possibility of a conflict of interest, we have deleted the Program Suggestion recommending that an active researcher be added to the Advisory Council.

We appreciate your cooperation and assistance and that of the Reserve staff during the accomplishment of this evaluation.

Sincerely,

Donna Wieting  
Acting Director

Enclosure

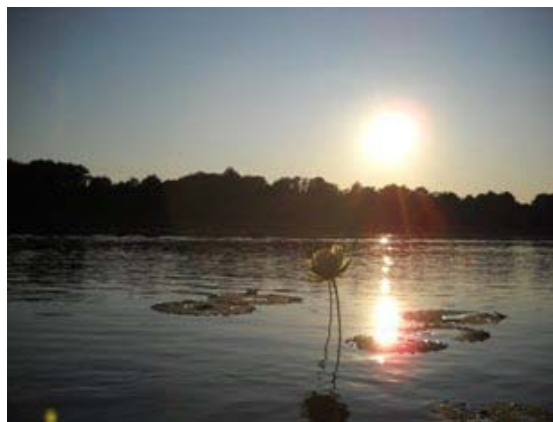
cc: Dave Graham, Chief, Division of Wildlife, Ohio Department of Natural Resources  
Dave Scott, Group Administrator, Division of Wildlife, ODNR  
Frank Lopez, Manager, Old Woman Creek NERR  
Tina O'Connell, Program Liaison, Estuarine Reserves Division, OCRM, NOAA  
Beth Thomas, Education Coordinator, North Inlet/Winyah Bay (SC) NERR

OWC NERR Management Plan, 2011 - 2016



**FINAL EVALUATION FINDINGS**  
**OLD WOMAN CREEK NATIONAL ESTUARINE RESEARCH RESERVE**  
**September 2006 through September 2009**

May 2010



All photos courtesy of Old Woman Creek NERR



Office of Ocean and Coastal Resource Management  
National Ocean Service  
National Oceanic and Atmospheric Administration  
U.S. Department of Commerce



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## I. EXECUTIVE SUMMARY

The Coastal Zone Management Act (CZMA) of 1972, as amended, established the National Estuarine Research Reserve System (NERRS). Sections 312 and 315 of the CZMA require the National Oceanic and Atmospheric Administration (NOAA) to conduct periodic performance reviews or evaluations of all federally approved National Estuarine Research Reserves (NERRs). The review described in this document examined the operation and management of the Old Woman Creek National Estuarine Research Reserve (OWCNERR or the Reserve) during the period from September 2006 through September 2009. The Reserve is administered by the Ohio Department of Natural Resources, Division of Wildlife (DOW).

This document describes the evaluation findings of the Director of NOAA's Office of Ocean and Coastal Resource Management (OCRM) with respect to the Old Woman Creek NERR during the review period. These evaluations include discussions of major accomplishments as well as recommendations for program improvement. The fundamental conclusion of the findings is that the State of Ohio is successfully implementing its federally approved NERR.

The evaluation team documented a number of Old Woman Creek Reserve accomplishments during this review period. The Reserve has transferred three core positions to 100 percent state funding. It receives strong support from *The Friends of Old Woman Creek*. Old Woman Creek NERR has also been very successful in using partnerships to conduct significant programs. The Ohio Coastal Training Program was developed as a regional partnership of four programs – the Reserve, the ODNR Office of Coastal Management, Ohio Sea Grant College, and the Ohio Lake Erie Commission. Those same four partners have formed the Lake Erie Partnership and are developing a unified strategic plan for Lake Erie outreach and education. The Friends of Old Woman Creek, the Reserve, and a great number of other organizations and individuals partnered to create the Firelands Coastal Tributaries Watershed Council, received state grant funding, hired a watershed coordinator, and completed development of the Old Woman Creek Watershed Action Plan. The work of the watershed coordinator has resulted in a variety of stewardship activities benefitting the Reserve.

The evaluation team also identified areas where the Reserve and its programming could be strengthened. The Reserve's management plan must be completed. The Reserve has accepted more federal CZMA funding even though it did not have sufficient state spending authority to expend those funds. The Reserve must submit financial assistance applications consistent with its available spending authority and must follow guidance from OCRM regarding awards open at the time these final findings are issued.

Coordination and communication between the research community and the DOW must be improved so that the Reserve is managed for long term protection and as a stable platform for research. The Reserve must establish a process to facilitate meetings and to serve as a link between researchers and the DOW.

## II. PROGRAM REVIEW PROCEDURES

### A. OVERVIEW

The National Oceanic and Atmospheric Administration (NOAA) began its review of the Old Woman Creek Reserve in July 2009. The §312 evaluation process involves four distinct components:

- An initial document review and identification of specific issues of particular concern;
- A site visit to Ohio, including interviews and public meetings;
- Development of draft evaluation findings; and
- Preparation of the final evaluation findings, partly based on comments from the state regarding the content and timetables of recommendations specified in the draft document.

The recommendations made by this evaluation appear in boxes and bold type and follow the findings section where facts relevant to the recommendation are discussed. The recommendations may be of two types:

**Necessary Actions** address programmatic requirements of the CZMA's implementing regulations and of the Old Woman Creek Reserve approved by NOAA. These must be carried out by the date(s) specified;

**Program Suggestions** denote actions that NOAA's Office of Ocean and Coastal Resource Management (OCRM) believes would improve the program, but which are not mandatory at this time. If no dates are indicated, the state is expected to have considered these Program Suggestions by the time of the next CZMA §312 evaluation.

A complete summary of accomplishments and recommendations is outlined in Appendix A.

Failure to address Necessary Actions may result in a future finding of non-adherence and the invoking of interim sanctions, as specified in CZMA §312(c). Program Suggestions that are reiterated in consecutive evaluations to address continuing problems may be elevated to Necessary Actions. The findings in this evaluation document will be considered by NOAA in making future financial award decisions relative to the Old Woman Creek Reserve.

### B. DOCUMENT REVIEW AND ISSUES DEVELOPMENT

The evaluation team reviewed a wide variety of documents prior to the site visit, including: (1) Old Woman Creek Reserve §312 evaluation findings dated 2006; (2) federally approved Environmental Impact Statement and program documents; (3) financial assistance awards and work products; (4) semi-annual performance reports; (5) official correspondence; and (6) relevant publications on natural resource management issues in Ohio.

Based on this review and on discussions with OCRM, the evaluation team identified the following priority issues:

- major accomplishments during the review period;
- status of Reserve staffing and needs;
- facilities development and/or land acquisition efforts;
- status of general administration of the Reserve and management plan revisions;
- status of implementation of the Reserve’s research, monitoring, and education programs;
- the manner in which the Reserve coordinates with other governmental and non-governmental organizations and programs in the state and region; and
- the manner in which the Reserve has addressed the recommendations contained in the §312 evaluation findings released in 2006. The Old Woman Creek Reserve’s assessment of how it has responded to each of the recommendations in the evaluation findings dated 2006 is located in Appendix B.

### **C. SITE VISIT TO OLD WOMAN CREEK NATIONAL ESTUARINE RESEARCH RESERVE**

Notification of the scheduled evaluation was sent to the Ohio Department of Natural Resources, members of Ohio’s congressional delegation, and regional newspapers. In addition, a notice of NOAA’s “Intent to Evaluate” was published in the Federal Register on September 2, 2009.

The site visit to the Old Woman Creek Reserve was conducted from October 6 – 8, 2009. The evaluation team consisted of Ms. Chris McCay, Evaluation Team Leader, National Policy and Evaluation Division, OCRM; Mr. Greg Gervais, Program Evaluator, National Policy and Evaluation Division, OCRM; Mr. Matt Chasse, Program Specialist, Estuarine Reserves Division, OCRM; and Ms. Beth Thomas, Education Coordinator, North Inlet/Winyah Bay (South Carolina) National Estuarine Research Reserve.

During the site visit, the evaluation team met with Old Woman Creek Reserve staff, senior staff from the ODNR Division of Wildlife, other state agency staff, coastal researchers, educators, NOAA National Weather Service, local government staff and officials, Old Woman Creek Advisory Council members, and non-profit organizations. Appendix C lists people and institutions contacted during this review.

As required by the CZMA, NOAA held an advertised public meeting on Wednesday, October 7, 2009, at 6:00 p.m. at the Old Woman Creek Reserve Visitor Center, 2514 Cleveland Road East, Huron, Ohio. The public meeting gave members of the general public the opportunity to express their opinions about the overall operation and management of the Old Woman Creek Reserve. Appendix D lists individuals who registered at the meeting. NOAA’s responses to written comments submitted during this evaluation are summarized in Appendix E.

The Old Woman Creek Reserve staff members were crucial in setting up meetings and arranging logistics for the evaluation site visit. Their support is most gratefully acknowledged.

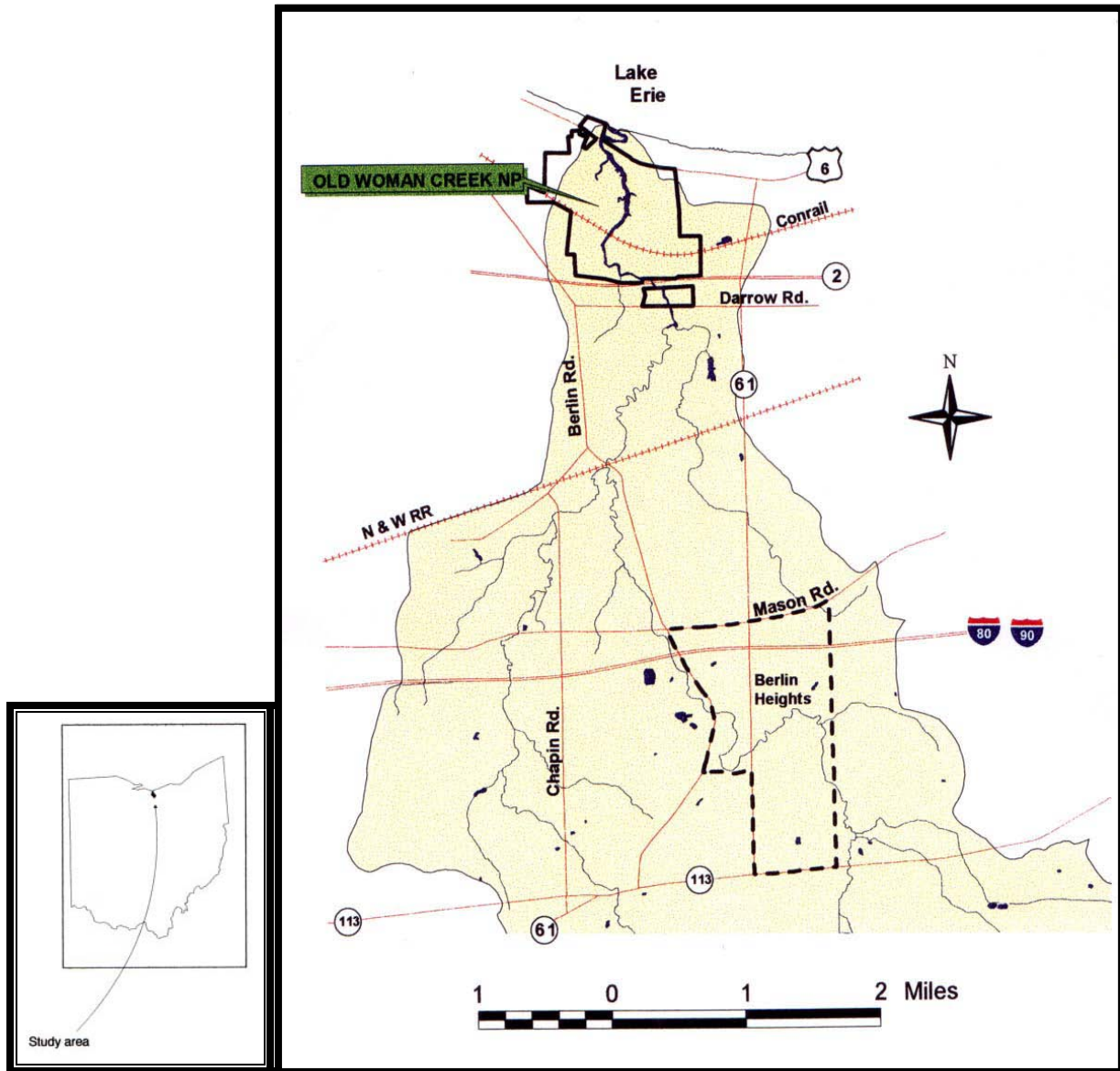
### III. RESERVE PROGRAM DESCRIPTION

NOAA's Office of Ocean and Coastal Resource Management designated the Old Woman Creek National Estuarine Research Reserve (OWC NERR or the Reserve) in 1980. The lead agency is the Ohio Department of Natural Resources (ODNR), Division of Wildlife (DOW). The Reserve is also a dedicated State Nature Preserve under the Ohio Natural Areas Act of 1970.

The Reserve is located on the south-central shore of Lake Erie at the mouth of Old Woman Creek. Old Woman Creek flows 15 miles through portions of Huron and Erie counties before draining into Lake Erie, three miles east of the city of Huron in Erie County. About a mile before entering Lake Erie, the channel of Old Woman Creek becomes submerged, and the slow-moving estuarine portion of the creek flows northward to Lake Erie. Only a portion of the Old Woman Creek watershed is encompassed within the boundaries of the Reserve. The major land use in the OWC watershed is agriculture, although the area is experiencing outward growth from the city of Huron and the village of Berlin Heights. Growth in planning and construction of residential subdivisions and light industry has been brought about, in part, by improvements to transportation infrastructure near the Reserve.

The smallest Reserve in the NERR system, the 573-acre OWC NERR is currently the only Great Lakes freshwater estuary in the NERR system and is one of Ohio's few remaining examples of a natural estuary. It encompasses significant estuarine, lacustrine, and terrestrial habitats, including open water, marsh, mudflat, oak-hickory upland hardwood forest, swamp forest, and sandy barrier beach. The coastal wetlands of the Reserve are located at the mouth of the creek, adjacent to Lake Erie. The estuarine portion of the wetlands is approximately 65 acres in size and extends about 1.3 miles south of the Lake Erie shoreline. The estuary is approximately 0.2 mile wide at its widest portion. Depths may reach 12 feet in the inlet stream channel, but most of the estuary is less than 20 inches deep. The estuary's outlet to Lake Erie at the stream mouth may be closed for extended periods of time by shifting sands of the barrier beach. When the mouth is open, occasional large seiches on Lake Erie (vertical oscillation, or sloshing back and forth of lake water after a wind setup) cause lake water to enter the estuary and spill into the wetlands.

The reserve also comprises a diverse and important assemblage of native plants and animals representative of freshwater estuaries. Common aquatic vascular plants include the American water lotus, fragrant water lily, duckweed, sedge, and arrowhead. The extensive lotus beds provide important habitat for fish and benthic macroinvertebrates. Common fishes found in the estuary include large-mouth bass, brown bullheads, sunfish, perch, shiners, and shad, many of which use the estuary as a critical spawning or nursery ground. Common birds at the Reserve include ducks, herons, songbirds, and migratory shorebirds. Several endangered or threatened species, such as the American bald eagle, use the estuary during the year. Other ecologically significant aquatic organisms found in the estuary include plankton, benthic algae, invertebrates, amphibians, and turtles.



OLD WOMAN CREEK NATIONAL ESTUARINE RESEARCH RESERVE

## IV. REVIEW FINDINGS, ACCOMPLISHMENTS, AND RECOMMENDATIONS

### A. OPERATIONS AND MANAGEMENT

#### 1. Administration and Staffing

The staff members of the Old Woman Creek NERR are well respected by everyone with whom the team met. They have built several significant partnerships that will be discussed elsewhere in these findings. Staff members have played roles in a variety of local, regional, and national efforts during the period covered by this evaluation. The Reserve hosted the NERRS/NERRA annual meeting in October 2006, and the Reserve manager now serves as the NERRA representative to the annual meeting planning process. The Coastal Training Program (CTP) coordinator serves as co-chair of the NERRS CTP Performance Monitoring Workgroup, as a member of the CTP Planning and Implementation Workgroup, was co-chair of the CTP Visioning Workgroup, and was instrumental in helping to develop the revised CTP logic model. The research coordinator serves on a NERRS plankton biomonitoring workgroup, and the education specialist serves on a NERRS education workgroup to develop a middle school curriculum focus on estuaries. The reserve manager serves as one of the wildlife management and research representatives on the executive committee for strategic planning to update the Division of Wildlife strategic plan. The manager also serves on the executive committee of the Firelands Coastal Tributaries Watershed Council, and three other staff members serve on other watershed program committees. Finally, the manager and CTP coordinator have reviewed Sea Grant pre- and full proposals, while the manager serves on the Lake Erie Commission Grants committee, reviews the Ohio Coastal Management Program assistance grants and Coastal and Estuarine Land Conservation program submissions, and serves on an ODNR committee to develop state proposals for the Great Lakes Restoration Initiative.

In 2008 the Reserve moved three core staff positions (manager, research coordinator, and coastal training (CTP) coordinator) to 100 percent state funding. Until then, those positions had been funded at a 70% federal/30% state funding split. This arrangement now provides continued state support for those positions as well as a significant portion of required non-federal match dollars.

**ACCOMPLISHMENT: The Reserve has transferred three core staff positions to 100 percent state funding. This provides ongoing state support for those positions and a significant portion of the necessary non-federal match dollars for operations awards.**

The Reserve has been without a full-time education coordinator since before 2003, when the previous Old Woman Creek NERR education coordinator retired. Shortly after the last evaluation site visit in August 2006, the CTP coordinator position was made permanent; since then the CTP coordinator has assumed oversight of the education programs. A part-time education specialist (1000 hours/year, non-permanent position) is the only staff member whose

primary duties are to implement the Reserve's K-12 and community education programs, although some graduate students and interns help with the programs. In the latter half of 2009, that staff member had exceeded total authorized work hours for the year and was furloughed. Other Reserve staff members met the existing commitments for staff-led education programs, but new requests for staff-led programs could no longer be accepted.

The last evaluation findings dated December 2006 included a Necessary Action that required a full-time education coordinator in place by the date of the next evaluation site visit. That did not occur, although several weeks after this evaluation's site visit, the Reserve received authorization to advertise a full-time, term-limited position for an education coordinator. Since then, there was an open advertising period, interviews were held, and an applicant was offered and accepted the position. The Reserve now has a full-time education coordinator on staff.

In this evaluation, four other staffing issues are of some concern to the long-term operation of the Reserve. First, the current research coordinator has been with the Reserve for a lengthy period of time and could retire within several years. It would help to maintain continuity if the Reserve and the Division of Wildlife are able to hire a new research coordinator before the current coordinator leaves and to arrange the same system of overlap that occurred with the previous and current Reserve managers.

Second, the Reserve operates without a dedicated Systemwide Monitoring Program (SWMP) technician. Some of the tasks assumed by SWMP technicians at other reserves are handled by Old Woman Creek Reserve's research coordinator and part-time contract employees. That is not an ideal situation, since the research coordinator has a significant workload, and the Reserve received the same allocation of federal funds as reserves with at least one SWMP technician.

Third, the Reserve's GIS capacity and capability are being addressed on an interim basis with a shared position whose primary responsibilities are for offshore wind energy planning and development. Because there is an ongoing need for GIS capability at the Reserve and in its partnerships and programs, the Reserve may want to look for ways to address that need on a more permanent basis.

Finally, the Reserve manager continues to serve as the stewardship coordinator in addition to carrying out his activities associated with being the manager. The Reserve relies heavily on partners to conduct many stewardship activities. This situation may not best serve the manager and his heavy workload, and the Old Woman Creek watershed coordinator (not an employee of the Reserve), who has conducted many stewardship activities, is in a position that ends December 2010. (Since the evaluation site visit was completed, the Reserve has formalized a partnership with the Erie Soil and Water Conservation District to support Reserve stewardship activities. This partnership will also support water quality monitoring within the Old Woman Creek watershed. A portion of the Reserve's federal financial assistance award will now be directed to the Erie Soil and Water Conservation District for these activities, which includes maintaining the Old Woman Creek watershed coordinator position.)

Throughout this evaluation period, the Reserve has had significant difficulty expending its federal CZMA financial assistance awards, and in fact has failed to spend the entire amount of



those awards during this time. The Reserve did not spend over \$500,000 awarded from three grants whose periods of performance ended during this evaluation period (FY05, FY06, and FY07). This amount represents approximately 30 percent of the federal funds available in the awards. Staff at OCRM's Estuarine Reserve Division were never notified of the problem during the three-year period. Because these awards were not extended nor the unspent funds reprogrammed, the funds were returned to the U.S. Treasury and were unavailable for NERRS program purposes. At the time of the site visit, two awards were still open (FY08 and FY09), but the levels of expenditures to date appeared to indicate that these awards would end with considerable funds unspent.

Biennially, the Ohio Legislature authorizes the amount of funding that the Department of Natural Resources (as well as other state agencies) may expend. The ODNR then provides the Division of Wildlife (as well as other divisions and programs in the Department) an amount of spending authority it must divide among its programs. The Reserve does not receive budget authority based upon the amount of its CZMA financial awards, which is the major reason why federal funds remain unspent. This was true for all awards throughout this evaluation period.

However, the Reserve continued to accept more federal funding even though it did not have sufficient budget authority to expend the funds. It did not seek extensions or reprogramming for those awards. In each award, the Reserve matched the federal dollars it expended but did not report in performance reports to OCRM on the expenditure of the excess match to which it had committed in its cooperative agreement award. Both actions represent mismanagement of the federal awards, not to mention a lost opportunity for the use of the funds for the reserve system, and must be corrected. Performance reports for the Section 315 awards (operations funds) appear to show that the Reserve generally met most of the task outcomes identified in the awards. However, based on the level of detail provided in the Reserve's performance reports, the line items for "contracts" and "equipment" were the only ones that clearly showed allocated funds that were not expended. It is somewhat difficult, therefore, to determine whether all tasks were completed using less money than originally identified as necessary for completion, or whether some tasks might be incomplete because all federal funding necessary for those tasks could not be expended (e.g., equipment purchase).

During the site visit, the evaluation team and Division of Wildlife and Reserve management personnel discussed the lack of sufficient budget authority and awards for funding beyond that authority. Several options were discussed to handle both the situation with existing open awards and for future awards:

- For future awards, the Reserve could seek or be awarded only federal funding for which the Reserve has spending authority, even if that amount is less than the share amount identified as available to reserves in any given year.
- For open awards (FY08 and FY09), the Reserve could request no-cost extensions to allow unexpended funds to be spent when FY10 state budget authority is available. Only a portion of available FY10 funding, not to exceed the remainder of available authority, or no FY 10 funding, would be obligated.

- The Department of Natural Resources and the Division of Wildlife could also attempt to obtain additional budget authority for the Reserve from the Ohio Legislature based upon the amount of federal funding available, although staff indicated this probably would not be successful.
- The Reserve could seek to identify a partner organization that can legally receive Section 315 grant awards directly from NOAA to conduct specific Reserve operations activities, thus reducing issues with the Reserve's available spending authority. A very limited number of Reserves use this approach, and OCRM must agree with the selection of such a partner and its abilities to conduct and complete the tasks identified for it.

Whatever actions are taken, the Reserve must not seek nor accept Section 315 funds for Reserve operations and management in an amount greater than the amount of the Reserve's state budget authority.

Since the site visit, the ODNR Division of Wildlife and Reserve staffs worked with OCRM's Estuarine Reserves Division (ERD) to craft a solution for FY10 funding. No-cost extensions to June 2011 were granted for the open FY 08 and 09 Section 315 awards. From the FY10 Section 315 funds, no monies were awarded to the Reserve, but \$90,000 was granted directly to the Erie Soil and Water Conservation District to conduct stewardship activities and to pay the salary of the watershed coordinator position. The Division of Wildlife and the District entered into a memorandum of understanding so this could occur. The remainder of FY 10 Section 315 funding generally available to the Reserve was then made available to the NERR system. The ODNR has indicated it will use only budgeted authority as the basis for future awards and will use OCRM guidance for future cooperative agreement applications.

**NECESSARY ACTION: The Reserve, ODNR Division of Wildlife, and OCRM should discuss options to overcome the lack of sufficient state budget authority available to the Reserve. The Reserve must submit financial assistance award applications consistent with the available spending authority and must follow guidance from OCRM to address awards open at the time of the issuance of these final findings.**

## 2. Management Plan

The Reserve's management plan was originally completed and approved in 1983. It has been updated twice since then, most recently in 1999. Because NERRS regulations require management plans to be updated every five years, the Reserve's plan revision is long overdue. The last evaluation findings dated December 2006 included a Necessary Action that required the Reserve to submit a final draft plan to OCRM no later than May 31, 2007. The Reserve had started the revisions before the last site visit but has still not completed them at the time of these final findings. As previously noted in the "Program Review Procedures" section, failure to address Necessary Actions may result in a future finding of non-adherence and the invoking of interim sanctions, as specified in CZMA §312(c). The findings in this evaluation document will be considered by NOAA in making future financial award decisions relative to the Old Woman Creek Reserve.

**NECESSARY ACTION: Updates to Old Woman Creek Reserve’s management plan are overdue by five years beyond the five year update period. The Reserve must complete updated revisions to its management plan. The completed final plan must be submitted to OCRM no later than September 30, 2010.**

### 3. Facilities and Infrastructure

During this evaluation period, the Reserve completed two additional trail sections near the Mike DeWine Center for Coastal Wetlands (the Reserve’s Visitor Center) and an access path for stewardship activities on the east side of Old Woman Creek estuary. As part of a partnership with Erie-Huron-Ottawa Vocational Education, summer work crews funded with American Recovery and Reinvestment Act monies built paths, did boardwalk cleaning, and trimmed trees, and volunteers have also helped with boardwalk enhancements, among other projects. Other routine maintenance tasks (e.g., custodial service, lawn mowing, and aquarium care) were outsourced to allow staff to devote time to priority tasks.

The Reserve’s exhibits in the Visitor Center are being renovated. Funding was approved and awarded, and the Reserve contracted with a museum consultant, who conducted a focus group to incorporate the group members’ feedback in exhibit planning. The 1980s-era exhibit panels being replaced are moveable, which has allowed the space they occupy in the Visitor Center to be used for larger group meetings, coastal training program events and trainings, and K-12 and community education programs when necessary. That larger space will be lost when the new and immobile exhibits are installed. The Reserve added a distance learning capability to its one small classroom to conduct educational programs remotely, but education staff indicated that existing facilities and a smaller Visitor Center open space do not and will not meet the existing needs of teachers and students. In addition, office space at the Visitor Center is at capacity, with very limited options for additional staff.

As research activities have increased, the research dormitories have reached capacity during the summer field season. Researchers with whom the evaluation team met noted difficulty in finding dorm space during the summer.

Several Old Woman Creek NERR Advisory Council members and many of the researchers, educators, and partners with whom the evaluation team met expressed concern about facility limitations and a desire to see the Reserve’s facilities expanded. The Reserve’s management plan includes a “Facilities” section, but the Reserve may want to consider a more definitive or immediate master planning process to address the current need for additional meeting, classroom, office, and dormitory space, as well as ongoing and periodic maintenance needs that are larger or more complex than can be handled by volunteers or janitorial services. Because some people acknowledged that a needed expansion may also increase the number of visitors without an increase in staff to assist and provide programming and may affect the resources of the Reserve, a facilities master planning process would be an appropriate place to consider those visitor and resource impacts as well. This process could be an action identified in the Facilities section of the management plan for completion or, if completed before the management plan is

completed, could be incorporated into or inform the management plan Facilities section.

**PROGRAM SUGGESTION: The Reserve should plan and implement a master planning process to address facility needs for classroom programs, teacher training, CTP training, public meeting space, staff office space, and lodging/dormitory space for students, teachers, and visiting researchers. The planning process should also take into account visitor and resource impacts of facilities expansion and ongoing and periodic maintenance requirements to ensure informed decision-making.**

#### 4. Coordination and Partnerships

The staff focuses on coordinating and integrating the Reserve's Coastal Training Program, education, research, and monitoring programs. For example, the Reserve has provided water quality monitoring opportunities as part of an educational component (also discussed in the Monitoring Section). One of the Reserve's interns developed high school level educational curricula based upon research done by a NOAA Hollings Scholar at Old Woman Creek.

The Reserve has effective partnerships with a variety of agencies and organizations. The major partners are the Ohio Coastal Management Program (housed within ODNR), Ohio Sea Grant, the Erie Soil and Water Conservation District, and the Lake Erie Commission. (The Lake Erie Commission is composed of the directors of the Ohio Departments of Agriculture, Development, Health, Natural Resources, and Transportation as well as the Ohio Environmental Protection Agency). Along with the Reserve, these partners are contributing to the implementation of the CTP, the Lake Erie Partnership and Lake Erie Literacy, and Old Woman Creek Watershed Action Plan. These programs and efforts will be discussed elsewhere in these findings.

The Reserve and the NOAA National Weather Service (NWS) have partnered for a number of years. The NWS maintains and upgrades the Reserve's weather station and provides a real-time weather display in the Visitor Center at no cost to the Reserve. During this evaluation period, NWS staff members in Cleveland also have been working with the Reserve in developing the content of an interactive NOAA kiosk at the Visitor Center. Under the rubric of the *One NOAA* initiative, the kiosk will demonstrate the relationship of the Reserve and the NWS. It also will discuss how weather conditions affect the Reserve and show the effects of climate change on the Great Lakes and Old Woman Creek. When completed, it will raise the visibility of the NWS and NOAA at the Reserve and provide educational opportunities for the Reserve and its visitors.

In July 2009, Erie MetroParks, the Reserve, and the Friends of Old Woman Creek partnered to host Bio Blitz 2009, using MetroPark properties within the watershed at Hoffman Forest and Edison Woods in addition to the Reserve. Volunteers were also able to participate in this 24-hour extensive study of all the life in one particular area.

In 2008 the Reserve partnered with Bowling Green State University-Firelands, the Firelands Tributaries Coastal Watershed Program, the Firelands Tributaries Coastal Volunteer Stream Monitors, and the Erie Soil and Water Conservation District to provide real-life chemistry experience for students and to support volunteer water quality monitoring efforts.

**ACCOMPLISHMENT: The Old Woman Creek has been very successful during this evaluation period in using partnerships to conduct significant programs such as the Ohio Coastal Training Program. Many of these partnerships also serve to integrate the Reserve’s many education, research, and stewardship activities.**

#### 5. Volunteer Support and Non-profit “Friends” Group Support

The Reserve receives support from both individual volunteers and the *Friends of Old Woman Creek* non-profit organization. Volunteer activities include helping to staff the Visitor Center; assisting with education programs, research, and stewardship activities; providing some clerical and maintenance support; and helping with special projects and events. Two program volunteers received awards from the Erie County Volunteer Center in recognition of their service to the Reserve. As tracked by the Reserve’s volunteer coordinator, there was a 90 percent increase from 2006 to 2008 in volunteer service hours. During this evaluation period, volunteer efforts included construction and siting of wood duck boxes, and trail and interpretive markers. The Reserve also received additional support through the efforts of the Firelands Coastal Tributaries Watershed “Trib Team” of volunteer monitors (also discussed under the “Monitoring” section of these findings).

The *Friends of Old Woman Creek*, founded in 1998, supports the mission and goals of the Reserve through operation of a gift shop; financial support for special equipment, projects such as the watershed program or research and education efforts; fund raising; publication of a *Friends* newsletter; and assistance to Reserve staff. The *Friends* provided support and assistance to the Reserve in hosting the NERRS/NERRA 2006 Annual Meeting in Ohio and participated in other NERRS/NERRA annual meetings during this evaluation period.

Because of the shortage of office and other space in the Visitor Center, it is possible that the space occupied by the *Friends* gift shop would have to be given up to accommodate additional staff or the Reserve might have to charge the *Friends* a rental fee for the space. The evaluation team hopes both of those possibilities can be avoided. It could mean that the gift shop would be shut down entirely or that the relationship between the *Friends* and ODNR or the Division of Wildlife could deteriorate.

**ACCOMPLISHMENT: Volunteers and *The Friends of Old Woman Creek* organization have increased and broadened activities in support of the Reserve and its mission. During this evaluation period, volunteers constructed and sited wood duck boxes and trail and interpretive markers. *The Friends* also assisted the Reserve in hosting the NERRS/NERRA 2006 Annual Meeting.**

#### 6. Advisory Council

The Old Woman Creek NERR Advisory Council was established in 1982 and meets quarterly. It is composed of at least nine members, representing local government, local, regional, and statewide interest groups, agriculture, educational institutions, and a Great Lakes research

institution, all appointed by the ODNR Director. The evaluation team met with the Advisory Council during the site visit and was impressed with the strong support the members expressed for the Reserve, its activities, and the role it plays in the community. When the Reserve was transferred to the ODNR Division of Wildlife from the ODNR Division of Natural Areas and Preserves, it was hoped that the Council could increase its reach in terms of spreading a message about the Reserve's role and activities to traditional Division constituencies and help to counteract perceptions about any differences between the Division and Reserve missions and objectives, particularly as it relates to the Reserve's research responsibilities. The members said they believed that the public's perception of the Reserve has improved and that the Reserve's partnerships and collaborations with other public agencies and entities continue successfully. Given concerns raised by researchers in meetings with the evaluation team (see discussion under the "Research and Monitoring" section in these findings), there is still a role for the Council to play in communication and coordination.

## 7. Geographic Information System (GIS) Program

During this evaluation period, the GIS program developed products for the management plan revision, land acquisition, and other research or stewardship applications. It also acquired a plotter and a map-grade GPS unit.

When the Reserve was transferred to the Division of Wildlife, a joint appointment between the Reserve and the Ohio Coastal Management Program was developed to provide GIS support to the Reserve. Shortly before the end of this evaluation period, that position became vacant, and at the time of the site visit, a wildlife biologist from the Division of Wildlife had taken the lead role in supporting the GIS program at the Reserve. Part of his salary is paid from the Ohio Coastal Management Program's Section 309 funding. However, his primary responsibilities are related to offshore wind energy planning and development. Because there is an ongoing need for GIS capability at the Reserve and with its many partnerships and programs, the Reserve may experience a gap in that capability. The Reserve may want to look for ways to address its need for GIS capacity on a more permanent basis.

## **B. RESEARCH AND MONITORING**

### 1. Research Activities

The evaluation team was impressed with the breadth and depth of research conducted at the Reserve. Many researchers have been conducting research at the Reserve for years. Students, Reserve staff (including non-research staff members), and volunteers have conducted a variety of research projects at Old Woman Creek in addition to university and college professors and researchers. Five NERRS Graduate Research Fellows (GRFs) began or finished research projects during this evaluation period, while two NOAA Hollings Scholars conducted research at the Reserve as well. The Reserve and its research partners complete 35 publications, including theses, papers in peer-review journals, and technical reports during the time covered by this evaluation.

Some examples of research being conducted at the Reserve during this evaluation period include, but are not limited to:

- Primary production in Old Woman Creek estuary. This study is determining primary production rates using SWMP data collected by four dataloggers in the estuary.
- Chemical patterns and trends within the Old Woman Creek estuary. This study is examining the 25+ years of chemical data collected in monitoring programs to determine both annual and spatial trends in this data.
- Benthic macroinvertebrate populations associated with *Phragmites* and with *Typha* stands and the impact of *Phragmites* control techniques on these populations. This is but one of several research activities at the Reserve involving *Phragmites*.
- Understanding the role of a natural swale in mitigating the runoff from urban development. This work is a long-term project that will determine the effectiveness of a natural vegetated drainage swale in removing or transforming pollutants that result from a housing development after construction is completed. Research is being conducted by Reserve staff.
- Adaptation of a nutrient management tool to the waters of Old Woman Creek. This study adapts a GIS based tool and graphical user interface previously developed to model how farming practices can be modified to reduce nutrient loading (primary nitrogen) in Old Woman Creek.
- Carbon sequestration in lotic wetlands in temperate and tropical climates. This study looks at the role of different wetlands (in both the tropics and in the temperate zones) in trapping carbon in the sediments.
- Photochemical degradation of non-point source pollutants in the waters of Old Woman Creek NERR. This work examined the role of the estuary in breaking down selected organic compounds, particularly several pharmaceuticals such as ibuprofen, which may or may not be harmful to aquatic wildlife. The study was conducted by one of the Reserve's GRFs and was subsequently highlighted in the NOAA Coastal Services Center January/February 2010 edition of *Coastal Services*.
- Reduction of agricultural pesticides in the sediments of a coastal Lake Erie wetland. This work builds on earlier work that examined the photolytic breakdown of pesticides in the water column. This research examines the role of natural reducers in the sediments and their pore water for similar degradation of agricultural pesticides. It looks at the role of wetland sediments in breaking down sediment bound pesticides and was featured in the Ohio Sea Grant 2009 Fall/Winter Edition of *Twineline*.

**ACCOMPLISHMENT: The Reserve continues to provide excellent staff support and facilities for a varied range of researchers, including NERR Graduate Research Fellows and NOAA Hollings Scholars, many of whom return to conduct long-term projects.**

The Lake Erie Partnership agencies—the Old Woman Creek NERR, Sea Grant Ohio, the Lake Erie Commission, and the Ohio Coastal Management Program—have created a coastal research advisory panel. Researchers from the Partnership agencies meet to identify common research themes or needs and can then often identify projects which they can co-fund.

The evaluation findings dated December 2006 contained a discussion that indicated several people were concerned about the compatibility of the Division of Wildlife's single species approach and the Reserve's emphasis on ecosystems. Research partners expressed a strong desire for coordination and communication between researchers and the Division of Wildlife and for an opportunity to meet with DOW managers and administrators to discuss research projects and the Division's view of the research and coordinated goals and strategies. It included a program suggestion that the Reserve facilitate periodic meetings between DOW upper-level managers and administrators and Reserve researchers.

The Reserve's response to that program suggestion indicates various activities and actions that the Reserve staff and manager have taken to increase agency understanding of the Reserve program, its goals, and projects. It appears, however, that there were no meetings between DOW management and researchers who are not Reserve staff.

Based upon discussions the evaluation team had with researchers during the site visit, those researchers still expressed a strong desire for an opportunity to meet with DOW managers to discuss specific research projects and research in the Reserve in general. Those types of meetings might have prevented a serious situation that occurred. In addition to being a NERR, the Reserve is also a designated state preserve, and as such, it is managed according to ODNR land management goals and objectives, including aerial spraying to control *Phragmites*. As noted above, there are several ongoing research projects that involve studies of *Phragmites*. Either because of miscommunication or lack of communication, ODNR spraying to control *Phragmites* occurred and destroyed designated research project control plots. That situation also poses serious risk to students and others who might be in the field and be unaware that spraying is going to occur. Two long-time researchers indicated that they would conduct research elsewhere if the lack of coordinated planning and communication continues. Overall, the Reserve has provided a supportive environment for research and collaborative research between organizations. It has also been quite successful in bringing GRFs and other undergraduate and graduate students to the Reserve. However, the Reserve must ensure that communication and planning between researchers and DOW land stewardship staff, upper-level managers, and administrators is improved so that the Reserve is managed for long term resource protection and as a stable platform for research.

In comments provided on the draft evaluation findings (letter dated April 29, 2010), the Department of Natural Resources indicated that since the site visit, the Reserve manager planned the upcoming summer (2010) *Phragmites* treatment in the Reserve after consulting with researchers and determining their field season research objectives, then advising DOW staff as to areas to be targeted for control and areas that must be avoided. OCRM believes that this type of ongoing communication should be effective in preventing future treatment of areas included within ongoing research projects.



The letter indicates that the DNR does not think that "...continued management of *Phragmites* constitutes a threat to the Reserve as a stable platform for research." In fact, the goal of treatment is to restore natural conditions...." OCRM is not opposed to management of an invasive species. However, the destruction of areas of *Phragmites* that are part of ongoing research projects does threaten the Reserve's status as a stable platform for research. If it occurs without advance notice, it also threatens the health and safety of anyone in the immediate area.

The letter also questions whether the requirement included in the Necessary Action for a process to establish periodic meetings between researchers and Division of Wildlife staff serves a better purpose than does communication between researchers and the Reserve manager and research coordinator. A Program Suggestion was included in the previous findings dated December 2006 very similar to the Necessary Action below. The intent of these recommendations was and is not to replace communication from researchers to the Reserve manager to the DOW staff. Rather, as noted above, the intent was to provide a mechanism to address the perception still held by some that the DOW has a single species approach, while the Reserve's emphasis is on ecosystems, as well as to foster communication and coordination. Research partners in particular expressed a desire for periodic opportunities to meet face-to-face with managers and administrators in the DOW at the Reserve.

**NECESSARY ACTION: The Reserve must manage the lands and waters within its boundary for long term protection and as a stable platform for research. To that end, the Reserve must establish a process that allows Old Woman Creek Reserve staff to facilitate periodic meetings between researchers and Division of Wildlife land stewardship staff, upper-level managers, and administrators. Such meetings must foster communication, ensure coordination on proposed management actions affecting reserve lands and water, and promote increased awareness of reserve research and stewardship programs. The Reserve must provide a written description of the process to OCRM no later than September 30, 2010, and provide information about these meetings in the Reserve's semi-annual progress reports.**

## 2. Monitoring

The Reserve's System-wide Monitoring Program (SWMP) is in compliance with NERR SWMP requirements. The SWMP has four data loggers that are maintained at sites selected to provide information on both the impact of storms on the estuary and the role of the estuary in mitigating the storm runoff. Two sites near the mouth of Old Woman Creek provide information on the extent of lake water intrusion during wind setup and seiche events. Two of the sites are telemetered so that real-time data is transmitted to the Visitor Center for viewing.

Since the last evaluation, the Reserve has assisted with the development of the Firelands Coastal Tributaries Watershed Program's volunteer stream monitoring program called the Tribs Team. It began in 2007 and trains volunteers to investigate the water quality of two local streams. The Reserve also benefitted from Bowling Green State University-Firelands undergraduate chemistry students who analyzed water quality samples.

The Reserve has been able to replace and update datasonde infrastructure on an annual basis within the CZMA Section 315 operations awards. Given the significant problem the Reserve faces in terms of insufficient budget authority to spend those funds, however, it may become difficult to maintain that annual replacement and update schedule. According to NERRS SWMP equipment data in OCRM, Old Woman Creek Reserve will need to recapitalize SWMP sondes in FY 2012. The Reserve also lacks a SWMP technician, and that absence may be more keenly felt when the research coordinator, who assumes most of the SWMP responsibility, retires within several years.

## **C. EDUCATION AND OUTREACH**

### **1. Education and Outreach Programs**

The Reserve continues to maintain strong partnerships with numerous educators and offers a variety of programs for both K-12 students and teachers. Because the Reserve is located in a relatively rural area, the educational programs are carried out at schools, at the Reserve with planning and reservations in advance, and through a few distance learning opportunities. Because of significant funding reductions that local schools faced during this evaluation period, the Friends of Old Woman Creek established a Transportation Assistance Grant Program to support 4<sup>th</sup> – 6<sup>th</sup> grade environmental education field trips to the Reserve for the 2008-2009 school year. Grant amounts of \$150 per school in Erie and Huron counties were offered on a first come, first served basis.

All the educators with whom the evaluation team met praised the Reserve staff for knowledge and dedication in providing or adapting programs to meet particular needs. All agreed, however, that the lack of enough staff, and in particular an education coordinator, and insufficient classroom space were serious detriments to allowing the Reserve to meet demand for its education programs. Staff estimated that approximately 100 requests per year for education programs had to be turned down. As noted in the earlier section entitled “Administration and Staffing,” an education coordinator has now been hired. The CTP coordinator will continue to have general oversight responsibility for all of the Reserve’s education programs.

The Reserve’s community outreach and stewardship education series, Estuary Explorations, was initiated during this evaluation period. The series introduces the public to wetland ecology, current research at the Reserve, and other relevant topics. In 2007, public canoe excursions were added to the Estuary Explorations calendar.

The Reserve also offers professional teacher development opportunities. During the time period covered by this evaluation, the Reserve partnered with the Center for Ocean Sciences Education Excellence-Great Lakes and the Sea Grant programs of Ohio and Pennsylvania to design and host a two-day workshop for formal and non-formal educators of students in grades 4-10. The workshop focused on research investigating pesticide and pharmaceutical degradation in the sediment of Old Woman creek estuary. Teachers collected estuary sediment cores, extracted pore water, analyzed chemical composition, and discussed how this research could be

incorporated in their science curricula.

The Reserve's education specialist received facilitator training and then held workshops to train local teachers in the curricula of Project WILD, which is a wildlife-focused conservation program of the Council on Environmental Education; and in the curricula of Aquatic WILD, which emphasizes aquatic wildlife and aquatic ecosystems. It is organized in topic units and is based on the Project WILD conceptual framework. These activities are designed for integration into existing courses of study.

As in many other aspects of the Reserve's operation, the education staff takes advantage of working with a variety of local and state partners. For example, Bio Blitz 2009 was a cooperative effort between the Reserve and Erie MetroParks to provide an educational opportunity for citizens to join researchers and learn scientific collection techniques and assist with data collection.

Old Woman Creek NERR, the Ohio Coastal Management Program, Ohio Sea Grant, and the Ohio Lake Erie Commission have formed the Lake Erie Partnership and are developing a unified strategic plan for Lake Erie education and outreach. This five year outreach and education plan will actively engage coastal constituents in an effort to build knowledge on topics relevant to Ohio's role in the Great Lakes coastal ecosystem to achieve greater environmental literacy, personal safety, and an improved state economy. The plan will also create efficiencies within all four organizations through: more accurate outreach materials, less staff required at public events, increased public knowledge of the agencies and issues, clear lines of communication, and reduced duplication of efforts. As an initial part of this effort, the agencies identified a need for a place-based environmental literacy framework for Lake Erie. As a result, the *Lake Erie Literacy* project is being adapted from *Ocean Literacy: The Essential Principles and Concepts*. Lake Erie principles and concepts are being developed and undergoing public review.

**ACCOMPLISHMENT: The Old Woman Creek Reserve and its partners in the Lake Erie Partnership are developing a five-year outreach and education plan and have initiated the *Lake Erie Literacy* project.**

## 2. Coastal Training Program

The Reserve's Coastal Training Program (CTP) has developed as a regional partnership of four programs—Old Woman Creek National Estuarine Research Reserve, Ohio Sea Grant College Program, ODNR Office of Coastal Management, and the Ohio Lake Erie Commission—that collaborate to conduct research, provide education, and manage the natural resources of the Lake Erie coastal region. It is formally referred to as the Ohio Coastal Training Program, and its scope is the Lake Erie basin. These programs regularly join forces with non-profit organizations, universities, and other agencies to deliver science-based training to professionals throughout the Lake Erie watershed.

Based on partner input and decision-maker needs, the Ohio CTP's coastal training strategy for the Lake Erie basin was revised and reflects priority issues and training needs in stormwater and

watershed management, wastewater treatment, source water protection, renewable energy technologies, sustainable design and construction, and shore erosion management.

The CTP helped plan and sponsor the 2009 Ohio Stormwater Conference. In partnership with the Northeast Ohio Stormwater Training Council, the University of New Hampshire (UNH) Stormwater Center, CICEET, and the NOAA Coastal Services Center, the CTP offered “Stormwater System Design and Performance,” a multi-site workshop and field tour featuring the UNH Stormwater Center’s research on stormwater system design and performance. Over 200 engineers and stormwater professionals participated. The Ohio CTP planned and held a workshop called “Coastal Community Planning and Development.” During the course of this evaluation period the CTP offered 21 training events focused on stormwater, watershed and land use planning issues to over 1,800 local government officials, including engineers, plan reviewers, land use planners, zoning boards, and planning commissions.

The CTP agencies partnered with Ohio EPA and over a dozen other agencies and organizations to form a regional stormwater education training council. This council then developed a stormwater training mini-grant program to support collaborative efforts to meet the needs of local governments and professionals.

The Reserve’s CTP Coordinator has established an exit survey feedback and evaluation process for all workshops. The survey results are used to modify the training workshops. The CTP Coordinator is considering a follow-up survey six to 12 months after the course to track behavior changes and impacts of the training.

**ACCOMPLISHMENT: The Ohio Coastal Training Program is a strong collaborative partnership, which has led to a coordinated training approach that taps into the strengths and resources of each partner.**

#### **D. STEWARDSHIP AND RESOURCE MANAGEMENT**

Within the NERR system, many reserves conduct or accomplish programs or activities related to land acquisition, enforcement, restoration, restoration science, technical advice and support, and community education under the general rubric of stewardship and resource management. Because the Reserve has so successfully integrated its research and education components, elements of stewardship and resource management are identifiable in almost all of its activities and programs, as can be seen in the discussions above.

Although many of the NERRs have a dedicated stewardship coordinator, Old Woman Creek Reserve does not, nor is it required to have one. Instead, the Reserve manager serves in that capacity and depends upon strong partnerships to accomplish activities. The previous evaluation findings dated December 2006 noted some of the weaknesses with this situation. As an example, the 2006 evaluation findings described the Reserve’s inability to find willing sellers in its land acquisition efforts, which often requires an ongoing concerted effort. The Reserve manager, who has a full workload, was not able to make a sustained effort. The 2006 findings included a Program Suggestion to explore strategies and options for identifying a position or person to assist

with land acquisition and other stewardship activities. The Reserve's response indicated that the Reserve continues to take a networked approach to stewardship. Although a particularly strong partnership (discussed below) achieved much in the way of stewardship during this evaluation period, the evaluation team remains uncertain that the Reserve manager has the time to perform the coordinating duties for stewardship.

The Reserve has continued to depend upon strong partnerships, and during this evaluation period, one particular partnership has been of clear stewardship value. The Reserve recognizes that community-driven watershed stewardship is essential for the protection of the estuary downstream. In response to interest shown by the *Friends of Old Woman Creek* in establishing a local watershed program, the Reserve, the Friends, and a great number of other organizations and individuals formed the Firelands Coastal Tributaries (FCT) Watershed Council. With the Friends acting as the fiscal agent and providing local match dollars, the Council received state grant funding from the Ohio Watershed Coordinator Grant Program (within the Department of Natural Resources). The Watershed Coordinator Grant Program funds are used to pay the salary of a watershed coordinator, for development of a watershed action plan, and ultimately for implementation of that plan. The four-year grant award will end in December 2010. The Erie Soil and Water Conservation District (one of the FCT Watershed Council members) now employs a watershed coordinator who works with local officials and community members to develop an action plan for Old Woman Creek.

The FCT Watershed Council has helped to update the Erie County stormwater and floodplain regulations, coordinated water quality monitoring training sessions for volunteers, coordinated a hardwood restoration project (Darrow Road tree planting) at the Reserve, established rain garden demonstration sites and conducted workshops, and has developed plans for Brod Ditch and Old Woman Creek restoration projects.

At this point an Old Woman Creek Watershed Action Plan has been developed and has received full endorsement from the ODNR and the Ohio EPA. The Action Plan provides an accounting of natural resource management objectives, including problems and concerns, and activities that watershed stakeholders will pursue to improve the watershed. The Reserve's site profile provided science and data that played a significant role in the management planning in the watershed. With funds available from the Great Lakes Restoration Initiative, having a watershed action plan in place may help the FCT Watershed Council in responding to request for proposals from the Initiative.

The work by the watershed coordinator, whose funding for the position ends in December 2010, has resulted in a variety of stewardship activities to complement activities conducted by Reserve staff. Since the evaluation site visit, the Reserve has formalized its partnership with the Erie Soil and Water Conservation District (ESWCA) to support reserve stewardship and watershed coordination activities. The ESCWA is expected to receive an FY10 federal financial assistance award to support these activities.

**ACCOMPLISHMENT: The Reserve and the Firelands Coastal Tributaries Watershed Council successfully found a funding source, employed a watershed coordinator for four years, and received full endorsement of the Old Woman Creek Watershed Action Plan.**

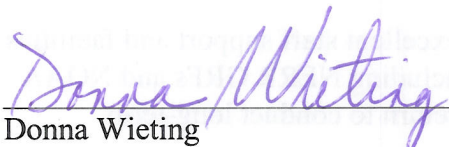
## V. CONCLUSION

For the reasons stated herein, I find that the State of Ohio is adhering to the programmatic requirements of the Coastal Zone Management Act and the regulations of the National Estuarine Research Reserve System in the operation of its approved Old Woman Creek National Estuarine Research Reserve.

The Old Woman Creek Reserve has made notable progress in: Administration and Staffing; Coordination and Partnerships; Volunteer Support and Non-profit "Friends" Group Support; Research Activities; Education and Outreach; Coastal Training Program; and Stewardship.

These evaluation findings also contain four (4) recommendations: three (3) Necessary Actions that are mandatory and one (1) Program Suggestion. The state must address the Necessary Actions by the date indicated. The Program Suggestion should be addressed before the next regularly-scheduled program evaluation, but it is not mandatory at this time. Program Suggestions that must be repeated in subsequent evaluations may be elevated to Necessary Actions. Summary tables of program accomplishments and recommendations are provided in Section VI.

This is a programmatic evaluation of the Old Woman Creek National Estuarine Research Reserve that may have implications regarding the state's financial assistance awards. However, it does not make any judgment about or replace any financial audits.

  
 Donna Wieting  
 Acting Director, Office of Ocean and Coastal  
 Resource Management

JUN 11 2010

\_\_\_\_\_  
 Date

## VI. APPENDICES

### Appendix A. Summary of Accomplishments and Recommendations

The evaluation team documented a number of the Ohio ODNR Division of Wildlife and Reserve's accomplishments during the review period. These include:

Issue Area	Accomplishment
Administration and Staffing	The Reserve has transferred three core staff positions to 100 percent state funding. This provides ongoing state support for those positions and a significant portion of non-federal match dollars.
Coordination and Partnerships	The Old Woman Creek has been very successful during this evaluation period in using partnerships to conduct significant programs such as the Ohio Coastal Training Program. Many of these partnerships also serve to integrate the Reserve's many education, research, and stewardship activities.
Volunteer Support and Non-profit "Friends" Group Support	Volunteers and <i>The Friends of Old Woman Creek</i> organization have increased and broadened activities in support of the Reserve and its mission. During this evaluation period, volunteers constructed and sited wood duck boxes and trail and interpretive markers. <i>The Friends</i> also assisted the Reserve in hosting the NERRS/NERRA 2006 Annual Meeting.
Research Activities	The Reserve continues to provide excellent staff support and facilities for a varied range of researchers, including NERR GRFs and NOAA Hollings scholars, many of whom return to conduct long-term projects.
Education and Outreach	The Old Woman Creek Reserve and its partners in the Lake Erie Partnership are developing a five-year outreach and education plan and have initiated the <i>Lake Erie Literacy</i> project.
Coastal Training Program	The Ohio Coastal Training Program is a strong collaborative partnership that has led to a coordinated training approach that taps into the strengths and resources of each partner.
Stewardship	The Reserve and the Firelands Coastal Tributaries Watershed Council successfully found a funding source, employed a watershed coordinator, and received full endorsement of the Old Woman Creek Watershed Action Plan.

In addition to the accomplishments listed above, the evaluation team identified several areas where the program could be strengthened. Recommendations are in the forms of Program Suggestions and Necessary Actions. Areas for improvement include:

<b>Issue Area</b>	<b>Recommendation</b>
Administration and Staffing	NECESSARY ACTION: The Reserve, ODNR Division of Wildlife, and OCRM should discuss options to overcome the lack of sufficient state budget authority available to the Reserve. The Reserve must submit financial assistance award applications consistent with the available spending authority and must follow guidance from OCRM to address awards open at the time of the issuance of these final findings.
Management Plan	NECESSARY ACTION: Updates to Old Woman Creek Reserve's management plan are overdue by five years beyond the five year update period. The Reserve must complete updated revisions to its management plan. The completed final plan must be submitted to OCRM no later than September 30, 2010.
Facilities and Infrastructure	PROGRAM SUGGESTION: The Reserve should plan and implement a master planning process to address facility needs for classroom programs, teacher training, CTP training, public meeting space, staff office space, and lodging/dormitory space for students, teachers, and visiting researchers. The planning process should also take into account visitor and resource impacts of facilities expansion and ongoing and periodic maintenance requirements.
Research Activities	NECESSARY ACTION: The Reserve must manage the lands and waters within its boundary for long term protection and as a stable platform for research. To that end, the Reserve must establish a process that allows Old Woman Creek Reserve staff to facilitate periodic meetings between researchers and Division of Wildlife land stewardship staff, upper-level managers, and administrators. Such meetings must foster communication, ensure coordination on proposed management actions affecting reserve lands and water, and promote increased awareness of reserve research and stewardship programs. The Reserve must provide a written description of the process to OCRM no later than September 30, 2010, and provide information about these meetings in the Reserve's semi-annual progress reports.



## **Appendix B. State's Response to Previous (2006) Evaluation Findings**

**Program Suggestion:** The Reserve should facilitate periodic meetings to be held at the Reserve between upper level managers and administrators in the Division of Wildlife and Reserve researchers to discuss ongoing research and projects; the needs of researchers; the Division's need for specific research, its mission and strategies, and how the Reserve fits in; and how the Reserve setting can provide a mutually beneficial opportunity for collaboration and cooperation on research.

**Response:** Since the 2006 program evaluation, the Chief and Assistant Chief have participated in OWC NERR Advisory Council meetings. The Reserve has hosted Wildlife Management, Business, and Information and Education meetings. Annually, the Reserve manager provides a presentation to regional Wildlife district meetings about the Reserve and specific research underway at the facility. The reserve manager has worked for the last year on a Division-wide steering committee to update the Wildlife strategic plan. These interactions have increased agency understanding of the Reserve program, its goals, and projects.

In 2008, the Division hired a project employee wildlife biologist through 309 funds from the Office of Coastal Management. The biologist has been stationed at the Reserve and is supervised by the Reserve manager. The primary task for this employee has been to develop protocols for avian species monitoring at prospective wind energy facilities.

The Reserve is one of the survey sites for an upcoming Ohio State University research project relating to *Lasiurine* bat species and their movements during migration along the Lake Erie shore. The wind energy biologist will be the research point of contact for this work and designed its methods and scope. The information from this study is critical to the Division of Wildlife to inform siting of wind energy facilities in the coastal zone.

**Necessary Action:** The Reserve and Division of Wildlife must continue to seek ways to maintain fully staffed education and CTP programs and must have a full-time education coordinator in place by the date of the next evaluation site visit.

**Response:** The Reserve has received permission to develop and post a full-time, three-year project employee position. The position will be posted this fall, following a national recruitment.

**Necessary Action:** The Reserve must complete updated revisions to its management plan. The completed final draft plan must be submitted to OCRM no later than May 31, 2007.

**Response:** The Reserve has submitted a complete draft for ERD review. The draft was completed in response to initial ERD comments received April 2009. The plan required extensive analysis of partner short term goals and strategies to facilitate on-going collaborations.

**Program Suggestion:** The Division of Wildlife should work with the ODNR and state information technology specialists to find a way to allow the installation and operation of the Reserve's distance learning infrastructure and to provide internet connectivity in the Reserve's classrooms and exhibit hall.

**Response:** No response provided. (However, distance learning infrastructure has been installed in the classroom area of the Visitors Center.)

**Program Suggestion:** The Reserve and Division of Wildlife should seek ways to create a permanent CTP Coordinator position that has sufficient time dedicated to maintaining and implementing a fully functional Coastal Training Program that meets all performance requirements.

**Response:** The CTP coordinator position has been transformed from a temporary project employee position to a classified position within the Division of Wildlife as a wildlife communication specialist. This could not have been accomplished without the strong support of the action by the Wildlife Management and Research Group Administrator and the Human Resources Group Administrator, given the current hiring climate.

Because of the nature of planning and scheduling training, there have been reporting periods wherein no programming was scheduled, which does not meet NERRS performance standards for content hours for that specific period. Otherwise, Ohio CTP training programs consistency perform at or above NERRS metrics. The program recently received ERD approval for its strategic plan for the upcoming three year period. The plan illustrates several collaborations on priority training topics such as land use planning and stormwater management practices

**Program Suggestion:** The Division of Wildlife and the Reserve should explore strategies and options for identifying a position or person to assist with land acquisition and other stewardship activities.

**Response:** The Reserve continues to take a networked approach to stewardship. The primary Reserve staff responsible for land management is the Reserve manager and part-time facilities manager. In order to be more efficient and provide more time to devote to land/habitat management, the Reserve has outsourced tasks like minor facility work, landscaping, etc. The Reserve participated in an OODNR job stimulus program this past summer. A crew of from three to five youth worked daily at the Reserve assisting with land management tasks. Within the Reserve boundary, Wildlife District Two staff assists with invasive species control, deer management, and law enforcement. Central office staff secures funds through sources like the USFWS aquatic invasive species grant to be used to treat invasive plants at the Reserve.

Without question, the greatest area of progress the Reserve has made toward stewardship goals has been through its support of local watershed planning and management through its affiliations with the Firelands Coastal Tributaries watershed program. The Friends of Old Woman Creek provide the local match for a watershed coordinator to develop a restoration/conservation plan

for Old Woman Creek consistent with a Total Maximum Daily Load Report from Ohio EPA. The Reserve has a synergistic relationship with the watershed program, providing research for the plan's resource inventory, training volunteer water quality monitors, and serving in leadership roles for the watershed program's education, restoration, and administration. The watershed coordinator has completed a watershed plan for Old Woman Creek and stands poised to begin project implementation after receiving plan approval from EPA and OODNR. The plan prioritizes several restoration projects that will reduce sediment and nutrient loading into the stream, estuary, and Lake Erie.

One of the initial restoration projects of the watershed program took place within Reserve boundaries. The coordinator planned and executed a volunteer tree planting in an emergent wetland area on the Reserve southern boundary. The area is being treated to remove reed canary grass. Water-tolerant tree species like Swamp White Oak and Pin Oak were planted to shade out the understory over time.

## **Appendix C. Persons and Institutions Contacted**

### Ohio Department of Natural Resources

Dave Graham, Chief, Division of Wildlife

Randy Miller, Assistant Chief, Division of Wildlife

Jim Marshall, Assistant Chief, Division of Wildlife

Dave Scott, Acting Group Administrator, Wildlife Management and Research, Division of Wildlife

Sue Howard, Group Administrator, Business Administration, Division of Wildlife

Michelle Ward-Tackett, Group Administrator, Human Resources, Division of Wildlife

Jen Dennison, Education Coordinator, Division of Wildlife

Sue Demers, Revenue Administrator, Division of Wildlife

Mickey Nygaard, Grants Coordinator, Division of Wildlife

Keith Lott, Biologist, Division of Wildlife

Jay Dorsey, Division of Soil and Water Conservation

John Watkins, Chief, Ohio Coastal Management Program

Matt Adkins, Nonpoint Pollution Program Coordinator, Ohio Coastal Management Program

Brenda Culler, Public Information Officer/Internet and Education Coordinator, Ohio Coastal Management Program

Brittany Huarcus, crew chief, Recovery Conservation Corps

### Old Woman Creek National Estuarine Research Reserve

Frank Lopez, Reserve Manager

Dr. David Klarer, Research Coordinator

Heather Elmer, Education Programs Coordinator and Coastal Training Program Coordinator

Phoebe Van Zoest, Education Specialist

Marge Bernhardt, Volunteer Coordinator

Gloria Pasterak, Office Assistant

Dick Boyer, Facilities and Equipment Maintenance Specialist

Colin Ward, NERR Graduate Research Fellow

### Old Woman Creek NERR Advisory Council

Bob Beidler, local landowner

Herb Chapin, local real estate agent

Dr. Bob Heath, Director, Water Resources Research Institute, Kent State University

Dr. Jeff Reutter, Director, Ohio Sea Grant College Program

Melinda Huntley, Tourism Extension Program Director, Ohio Sea Grant College Program

Floren James, retired extension agent

David Snook, Superintendent, Berlin-Milan Local Schools

Tom Stockdale, retired, Ohio State University School of Natural Resources

Steve Deehr, watershed farmer

Tom Ritzenthaler, Erie County Conservation Club

Yetty Alley, Local Liaison/CMAG Coordinator, Ohio Coastal Management Program

Friends of Old Woman Creek

Sue Cloak	Barbara Berg	Elaine Waterfield
Pam Leszynski	Sandy Burris	Linda Feix
Sandy Wright	Marian Hancy	Dorothy Koontz
Ed Enderle	Pat Krebs	

Federal and State Agency Representatives

Paul Svoboda, NOAA National Weather Service  
 Mike Abair, NOAA National Weather Service  
 Paige Gill, NOAA Coastal Services Center  
 Katie McKibben, Ohio Environmental Protection Agency  
 Chris Riddle, Ohio Lake Erie Commission

Local Government Representatives

Eric Dodrill, Erie County Soil and Water Conservation District  
 Breann Hohman, Erie County Soil and Water Conservation District  
 Celine Hemminger, Erie County Soil and Water Conservation District  
 Harry Stark, Cuyahoga County Board of Health  
 Lisa Beursken, Erie County Solid Waste Management Authority

Academic/Educational Representatives

James Houle, University of New Hampshire, Stormwater Center  
 Dr. Linda Cornell, Bowling Green State University, Firelands College  
 Dr. Bob Whyte, California University of Pennsylvania  
 Dr. Joe Holomuzki, Ohio State University at Mansfield  
 Dr. William Mitsch, Ohio State University  
 Kathleen Failor, Firelands Montessori Academy  
 Donna Fraelich, Western Reserve Middle School  
 Daila Shimek, Great Lakes Environmental Finance Center, Cleveland State University  
 Kirby Date, Maxine Goodman Levin College of Urban Affairs, Cleveland State University  
 Sharon Opfer, Erie-Huron-Ottawa Vocational Career Center

Other Organizations and Individuals

Sharon Barnes, Barnes Nursery  
 Kathie Mueller, Friends of Pipe Creek  
 Eddie Herdendorf, Ecosphere & Associates  
 Amy Brennan, Chagrin River Watershed Partners  
 Jeff Reutter, Director, Ohio Sea Grant College Program  
 Jill Jentes Banicki, Assistant Director, Communications Coordinator, Ohio Sea Grant College Program  
 Joe Lucente, Ohio Sea Grant College Program  
 Frank Lichtkoppler, Ohio State University Sea Grant Extension  
 Glenn Odenbrett, Science Education for New Civic Engagements and Responsibilities

**Appendix D. Persons Attending the Public Meeting**

The public meeting was held on Wednesday, October 7, 2009, at 6:00 p.m. at the Old Woman Creek National Estuarine Research Reserve Visitor Center, 2514 Cleveland Road East, Huron, Ohio. The following attended the meeting:

Gene Wright  
Jim Randall  
Tim Fields

## **Appendix E. NOAA's Response to Written Comments**

NOAA received no written comments regarding the management or administration of Old Woman Creek National Estuarine Research Reserve.

**Old Woman Creek NERR  
Management Plan**

**APPENDIX R**

**Facilities Maintenance Checklist – DeWine Center  
for Coastal Wetland Studies, OWC NERR**



## APPENDIX R. Facilities Maintenance Checklist – DeWine Center for Coastal Wetland Studies, OWC NERR

TASK - SITE	Weekly	Monthly	Quarterly	Yrly./ or as need	2-3 yrs.
<b>Indoor checklist</b>					
Inspect restrooms for cleanliness and supplies	X				
Clean/sanitize restrooms (daily, in season)	X				
Dust countertops/exhibit cases	X				
Dust for cobwebs		X			
Clean windows		X		X	
Clean/dust pictures/artwork		X			
Clean wet lab area	X	X		X	
Wax exhibit bottoms		X		X	
Floor care: dust mop daily; wash weekly	X				
Buff floors		X			
Floor care: wash/strip/wax/buff			X		
Vacuum carpets	X				
Clean entrance and windows		X			
Vacuum touch box		X			
Water plants	X				
Clean bird bath, fill pool	X				
Feed fish in aquariums		X			
Clean aquarium	X				
Empty trash	X				
Haul extra trash to re-cycle center or landfill		X			
Check trash dumpster	X				
Change batteries: CO <sub>2</sub> detector/smoke alarm				X	
Test exit lighting					
Inspect exhibit lights; replace as necessary				X	
Replace burned-out light bulbs in Center and outside				X	
Organize tool room		X			
Inventory supplies as needed		X			

**Facilities Maintenance Checklist – DeWine Center for Coastal Wetland Studies,  
OWC NERR**

<b>TASK - SITE</b>	<b>Weekly</b>	<b>Monthly</b>	<b>Bimonthly /season</b>	<b>Yrly./ or as need</b>	<b>2-3 yrs.</b>
<b>Outdoor checklist</b>					
Clean/update bulletin boards	X				
Paint signage			X		
Clean gutters		X			
Check for roadside trash	X				
Fill bird feeders	X				
Clean out nest boxes			X		
Plow snow in parking lots, driveways and walkways		X	X		
Sweep/blow paved hiking trail		X			
Wash mower	X		X		
Fertilize trees, plants, shrubs				X	
Prune trees and shrubs				X	
Mow/trim grass	X				
Mow weather station area	X				
Weed whip around barn	X				
Cut weeds around mail box	X				
Mow around barn and front gate area		X		X	
Mow boundary strip		X		X	
Spray weeds in parking area only		X		X	
Burn prairie					X
Control invasive species in estuary and adjacent uplands				X	
Mow with tractor				X	
Trail maintenance: woodchips/stone; sweep paved trail; clean ditches and culverts; inspect for dangerous overhanging limbs; unplug drainage			X	X	
Asphalt trail/patch/crack/fill					X

**Facilities Maintenance Checklist - Dormitories, Beach House, Boat House, Storage Buildings and Shop, OWC NERR**

<b>TASK - SITE</b>	<b>Weekly</b>	<b>Monthly</b>	<b>Bimonthly/ season</b>	<b>Yrly./ or as need</b>	<b>2 - 3 yrs.</b>
Clean dormitories and windows			X		
Inspect dormitories	X				
Clean restrooms, as necessary	X				
Clean porch areas				X	
Clean/update bulletin board	X				
Mow/trim area	X				
Weed flower beds		X			
Trim/prune bushes, trees, shrubs, vines on slope			X		
Mulch shrubs and flowers				X	
Monitor purple loosestrife, phragmites; remove			X		
Pickup roadside trash		X			
Empty trash barrels	X				
Straighten shop area	X				
Clean mowers and vehicles	X				
Paint/maintain signage				X	
Maintain beach access	X				
Pickup litter on beach	X				
Straighten workshop		X			
Maintenance to canoe launch (sand/gravel)			X		
Cleanup boat ramp area				X	
Clean canoes/paddles, etc.				X	
Clean eaves and spouting of shop and boat house				X	
Clean gutters seasonally			X		
Stone on drive areas				X	
Inspect septic tank seasonally			X		
Change batteries: CO <sub>2</sub> detector/smoke alarm				X	
Change furnace filters annually				X	
Clean septic tank					X
Winterize facility				X	
<u>Dorms</u>					
Clean gutters				X	
Change furnace filters				X	
Clean windows			X		
General indoor housecleaning			X		
Inspect and clean accordingly	X				
Change smoke alarm batteries				X	

# **Old Woman Creek NERR Management Plan**

## **APPENDIX S**

### **Mapping Land Use and Habitat Change in the NERRS: Standard Operating Procedures**

# MAPPING LAND USE AND HABITAT CHANGE IN THE NERRS: STANDARD OPERATING PROCEDURES

09/11/09

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## I. Introduction

In 2009, the National Estuarine Research Reserve System (NERRS) completed the suite of documents that are intended to guide mapping in the NERRS. These documents include the Habitat Mapping and Change (HMC) Plan, the NERRS Classification Scheme and associated documentation and implementation protocols. These documents are available on the NERRS Intranet site and soon-to-be revised NERR Internet site. The purpose of developing the HMC Plan and NERRS classification scheme was to establish consistency in mapping habitats and boundaries across the NERRS. Due to inconsistency in mapping standards and protocols, it has been impossible to characterize the habitats contained within our reserve system and how they are changing over time. Consistent terminology and standards will support the research, stewardship, education and outreach priorities of the NERRS and foster partnerships with state, regional and federal partners.

The goals of the NERR HMC planning effort are to: (1) develop a framework for mapping habitats and reserve/watershed boundaries to characterize and communicate at site, regional, and system-wide scales short-term variability and long-term trends in adjacent land use/land cover, local sea level, and spatial changes in reserve habitats; and (2) examine the impact of land use within adjacent watersheds, as well as changes in local sea level, on reserve habitats. Towards this end, the HMC Plan objectives are to: 1) map land cover/land use and associated changes in reserves and their watersheds; 2) model elevation and tidal datums in reserves and elevation in adjacent watersheds; and 3) enhance capacity within the NERRS to map, model and disseminate information on estuarine habitat trends and associated linkages with anthropogenic and climatic stressors.

These Standard Operating Procedures (SOPs) detail the methodology for developing and submitting boundary shapefiles and habitat maps to the Centralized Data Management Office (CDMO) in compliance with the HMC Plan. Adherence to the SOPs will establish system-wide consistency among reserves and ensure that QA/QC standards are met for all mapping products developed and made publicly accessible by the NERRS. Consistency in standards will facilitate analysis of habitat change within and among reserves and communicate trends in habitat change within the NERRS.

Mapping within the reserve watersheds will be conducted by the NOAA Coastal Services Center as part of the Coastal Change Assessment Program. Since the NERRS does not dedicate funding for mapping (except for a recommended \$20,000 of reserve operations award every year to support GIS capacity), the only requirement for reserves is to map their areas of perpetual interest (i.e., areas targeted for repeated high resolution mapping over time to monitor change) in accordance with the requirements in this SOP and pursuant to approved site-based habitat mapping and change plans. While the SOPs provide guidance on mapping reserve habitats outside areas of perpetual interest, mapping these habitats is voluntary until such time that the NERRS dedicate additional funding for mapping. However, since most reserves receive funds for mapping from sources other than the NERRS for specific applications,



compliance with the standards within the SOP is encouraged to the extent consistent with funding requirements so that these products can be posted on the CDMO website.

The SOPs focus on the methodologies, processes, and requirements for submitting the following mapping products:

- Reserve and watershed boundaries
- Land Use/Land Cover maps at multiple scales
- Change analysis
- Digital Elevation Models (DEMs)
- Processes for submitting products to the Central Data management Office (CDMO)
- Reserve Habitat Mapping and Change Plans

These SOPs will be evaluated and updated annually to address lessons learned, or the adoption of new national or NOAA mapping standards.

## **II. Boundaries**

Kutcher et al. (2008) recommended the implementation of a two-level approach to facilitate the objectives identified by Neider et al. (2002) that require characterization of land cover/land use both within reserve boundaries and in the watersheds that drain into them. The approach utilizes existing resources within NOAA and the US Fish and Wildlife Service (USFWS), using (1) Coastal-Change Analysis Program moderate-resolution data automatically classified to characterize reserve watersheds, and (2) recently developed classification and collection protocols (compatible with national wetland mapping standards) to characterize land cover and habitat types on reserve properties at higher resolution. This two-tier approach has the advantage of using consistent, efficient, and readily available C-CAP protocols to track changes in land use/land cover, percent impervious surface, and canopy cover within reserve watersheds at no cost and minimal effort to the NERRS, while also utilizing the NERRS Classification System to provide a standardized format to track habitat change at higher resolution within reserve boundaries. The recommendation for a two-level approach was approved for implementation by the reserve system in 2007 (SWMP Revision, 2007), and the specific data requirements related to reserve and watershed boundaries are detailed below.

### *A. Reserve Boundaries*

Reserve boundaries submitted to the CDMO must adhere to specific requirements or they will not be accepted for posting on the CDMO website:

1. Federal Geographic Data Committee (FGDC) compliant metadata. All reserve boundaries must have complete FGDC compliant metadata attached that details: (1) the base maps used to develop the boundaries and associated details about the base imagery or products, (2) the methodology for developing the boundaries, (3) projection, (4) the date the boundary was produced, (5) contact information, and (6)

other required information. The FGDC compliant metadata for boundaries is specified in the standard metadata information accessible at the ESRI Support Center (<http://support.esri.com/>).

2. Projection: All reserve boundaries must be submitted using Transverse Mercator projection which is appropriate for smaller geographic areas.
3. Frequency: Reserve boundaries must be replaced whenever a boundary amendment is made due to acquisition or inclusion of additional lands. Re-submitting the revised boundary map should be the final step in modifying boundaries and can only be completed after the Federal Register notice has been published announcing approval of the boundary amendment. The revised boundary shapefile must adhere to FGDC requirements and projection standards identified above.

### *B. Watershed Boundaries*

There are two, and at some reserves three, scales of watersheds that are mapped as part of this HMC Plan. The largest scale is the estuarine basin(s) within which the reserve is contained. It has been determined based on a flow analysis that most closely corresponds to a US Geological Survey (USGS) 8-digit Hydrologic Unit Code (HUC). This boundary has been developed for all reserves (except Jobos Bay and Kachemak) and has been uploaded to the CDMO web site. The methodology for creating the estuarine basin is described in the metadata of each reserve's boundary file.

Reserves have also identified an intermediate targeted watershed boundary. Targeted watersheds represent those watersheds that directly flow into and impact the habitats within reserves. In some cases, the targeted boundaries may correspond to the estuarine basin described above (e.g. Narragansett Bay NERR, RI), but in most cases, these are distinct boundaries. Targeted watersheds can represent: 1) the USGS 14 digit HUCs that only encompass the river systems directly flowing into the reserves; or 2) boundaries based on local knowledge. For example, a targeted watershed may encompass the watershed of a reserve's tributary such as the York River of the Chesapeake Bay that can bring water impacted by land uses down-stream of a reserve into the reserve on an incoming tide. These watershed boundaries have been uploaded to the CDMO web site.

In the case of some reserves, there may even be a third scale reflecting a small watershed adjacent to a particular reserve component. These smaller watersheds consist of the land cover/land uses that directly impact that particular reserve component and the size of these watersheds render C-CAP 30 m resolution imagery meaningless to evaluate land uses and their impacts on reserve habitats.. Reserves that contain a small watershed of interest have identified the boundaries of these basins. For example, a small watershed of the York River basin that directly impacts one particular component of the Chesapeake Bay, Virginia NERR

was delineated as was the small watershed flowing into the Elkhorn Slough NERR in California.

Watershed boundaries must have all metadata attached to meet the standard FGDC metadata requirements including: (1) the methodology in which boundaries were developed, (2) contact information, and (3) projection. All estuarine basin boundaries are to be projected using an Albers projection, and targeted and small watershed boundaries are projected in a Transverse Mercator projection.

### **III. *Land Cover and Land Use Maps***

Neider et al. (2002) established a strategy to implement a system-wide land use/land cover change analysis protocol. The document identified conceptual and technical objectives for tracking land use/land cover changes and led to the development of a NERRS Habitat Mapping and Change committee, as well as a Habitat Mapping and Change Technical Committee (HMCTC). The HMCTC developed strategies for (1) identifying and acquiring the appropriate imagery, (2) interpreting and classifying data, and (3) processing, formatting, and distributing the results. The technical tools and methods supporting those objectives are summarized in the following section and are organized based on the two-level approach (moderate and high resolution) of Kutcher et al. (2005) mentioned above. The different land cover/land use mapping strategies are described below and detailed data specifications are provided in Table 1.

#### ***A. C-CAP Moderate Resolution/High Classification Accuracy Land Cover Maps of Watersheds***

NOAA Coastal Services Center (CSC) has provided moderate resolution land cover data of each reserve's watershed and/or targeted watershed (except Jobos Bay and Kachemak) to the CDMO. Data were acquired and processed through a repeatable semi-automated protocol developed by Dobson et al. (1995) and implemented on a rotating five-year collection cycle since 1996. The protocol uses Landsat TM 30-m resolution, multi-spectral satellite imagery that is run through a series of spectral analyses and field verifications. The protocol is developed to achieve 85% overall mapping accuracy.

NOAA CSC has also provided maps characterizing impervious cover, canopy cover (produced by the U.S. Forest Service), and land use/land cover change within each reserve's watershed and targeted watershed (except Jobos Bay and Kachemak) to the CDMO. All NOAA CSC products are delivered in a pre-processed C-CAP format and no further processing or quality assurance is required. All maps are delivered in a single standardized Albers projection, which enables site as well as system-wide analysis.

#### ***B. High Resolution/High Classification Accuracy Maps of Reserve Habitats of Perpetual Interest***

Individual reserves are responsible for the acquisition and processing of high resolution land

cover data. These areas/habitats of perpetual interest can represent a specific geographic area (e.g., Redfish Bay in the Mission-Aransas NERR) or a specific habitat type throughout the entire reserve (e.g., wetlands). Smaller reserves may be able to identify all inter-tidal and supra-tidal habitats, while larger reserves may choose to select representative areas or priority habitats to monitor over the long term. The strategy must be consistent with the site-based habitat mapping and change plan. Classification to the subclass level is required with or without descriptors and/or modifiers. If high resolution data is available for sections of the reserve that are outside of “priority habitats,” the reserve may choose to classify these areas to a higher level of the NERR Classification Scheme, such as the class level (see **High Resolution/Moderate Classification Accuracy Maps of Reserve Habitat** section). For the purposes of producing baseline maps, those reserves not including sub-tidal habitats as areas of perpetual interest should classify sub-tidal habitats within the area of perpetual interest to the highest level of detail possible, even if this is just a placeholder at the subsystem level (e.g., denoting *estuarine sub-tidal haline*).

Various methods for acquiring and processing high resolution data are outlined in Neider et al. (2002) and Walker et al. (2006). Examples of available mapping techniques include, but are not limited to, aerial photography, satellite imagery, and acoustic surveys. Compatibility of data among the various reserves, regardless of imagery acquisition technique, will be achieved through the use of the NERRS Classification Scheme, standard dataset format, and standardization of scale and accuracy. Accuracy assessments for areas of perpetual interest are conducted at the sub-class level of the NERR classification scheme (see Accuracy Assessment section below).

### *C. High Resolution/Moderate Classification Accuracy Maps of Reserve Habitats Outside of Areas of Perpetual Interest*

Whenever possible, reserves should upload habitat maps derived from high resolution imagery classified to the subclass level of the NERRS Classification Scheme (see **High Resolution/High Classification Accuracy Maps of Reserve Habitats** section above). However, this is not always practical (or necessary) in many circumstances due to the size of reserves and/or limitation of resources. For those reserves that have high resolution imagery outside of the areas/habitats of perpetual interest, the mapping protocols and standards are more relaxed than those required for priority areas/habitats where change analysis will be conducted. For these “non-priority” areas, classification can be accomplished using automated classification methodologies and habitats can be classified to the class level of the NERRS Classification Scheme. An accuracy assessment at the class level of the NERRS classification scheme is required, and the accuracy assessment matrix and kappa statistic must be included in the metadata.

**Table 1. Data specifications for habitat mapping.**

	<b>Moderate Resolution/ High Classification Accuracy</b>	<b>High Resolution/ Moderate Classification Accuracy</b>	<b>High Resolution/ High Classification Accuracy</b>
Resolution	30-meter	1-meter or 3-meter (Reserves should refer to using highest resolution imagery available)	1-meter or 3-meter (Reserves should refer to using highest resolution imagery available)
Scale	1:100,000	1:12,000 or 1:24,000	1:12,000 or 1:24,000
Minimum mapping requirement	Watershed	Inter-tidal, supra-tidal	Inter-tidal, supra-tidal
Data source	LandSat Thematic Mapper multispectral satellite imagery	Varies depending on reserve	Varies depending on reserve
Data type	Raster	vector, polygon (shapefile)	vector, polygon (shapefile)
Data processing	C-CAP semi-automated protocol conducted by CSC	Dependent on data source	Dependent on data source
Target minimum mapping unit	0.09 ha (0.22 ac)	0.1 ha (0.25 ac)	0.1 ha (0.25 ac)
Classification	C-CAP ordered list	NERRS Hierarchical Classification System (class level)	NERRS Hierarchical Classification System (sub-class level)
Metadata	FGDC Compliant - produced by NOAA CSC	FGDC Compliant – produced by reserves	FGDC Compliant – produced by reserves
Projection	Albers	Transverse Mercator	Transverse Mercator
Collection Interval	5 years	Minimum of every 10 years	Minimum of every 10 years
Accuracy Assessment		Conducted at the Class Level of the NERR Classification scheme	Conducted at the Sub-Class Level of the NERR Classification scheme

#### D. Attribute Tables

Consistent data and data standards within attribute tables is critical for accumulating data over time within a reserve and among reserves. For this reason, the format and data within attribute tables must be consistent across reserves. For habitat maps submitted by the reserves to CDMO, each row of the attribute table represents a habitat unit (i.e., polygon) and each column provides information describing that particular unit. All attribute tables must contain, at a minimum, the columns listed in Table 2: The columnar format of the attribute table is the backbone of the high resolution land cover inventory, and therefore, is essential in allowing data interoperability between reserves and with other data producers and users. Consistently formatted attribute tables will enable analysis of reserve habitats and associated change over time across the NERRS. The attribute tables will be reviewed for conformance with the SOPs during the QA/QC process prior to posting maps to the CDMO website.

**Table 2. Minimum standard attribute columns required for high resolution habitat maps (modified from Walker et al. 2006).**

Parameter	Column Name	Description
System (Numeric)	Sys_Num	Level 1 classification using numeric codes.
System (Nominal)	Sys_Nom	Level 1 classification using nominal description.
Subsystem (Numeric)	SubSys_Num	Level 2 classification using numeric codes.
Subsystem (Nominal)	SubSys_Nom	Level 2 classification using nominal description.
Class (Numeric)	Cls_Num	Level 3 classification using numeric codes.
Class (Nominal)	Cls_Nom	Level 3 classification using nominal description.
Subclass (Numeric)	SubCls_Num	Level 4 classification using numeric codes.
Subclass (Nominal)	SubCls_Nom	Level 4 classification using nominal description.
Descriptor (Numeric)	Dsc_Num	Level 5 classification using numeric codes.
Descriptor (Nominal)	Dsc_Nom	Level 5 classification using nominal description.
Modifier (Nominal)	Mod_Nom	Level 5 classification using nominal description.
Feature Area	Area (in hectares)	Describes, in appropriate units, the area of the feature.

#### E. Accuracy assessment

Accuracy assessments are designed to provide quantitative information on the overall accuracy of the entire habitat classification dataset at the class level of the NERRS Habitat Classification Scheme for areas not identified as areas of perpetual interest and at the sub-class level for habitats within the areas of perpetual interest. The introduction of various types of error is unavoidable during land cover classification and change detection, whether using manual or automated methods. Consistent with the FGDC metadata requirements and the reserve

system's high standards for disseminating information, reserves are required to complete and submit an accuracy assessment analysis to validate high-resolution habitat maps. Without an accuracy assessment, the maps are of little use for long-term change analysis.

No minimum level of accuracy is required for the accuracy assessment analyses. The only requirement is that an accuracy assessment be conducted and included in the metadata. With that said, the FGDC Wetland Subcommittee has recently released a draft Wetland Mapping Standard (Heber, 2007), which outlines wetland mapping protocols intended to apply to any federally-funded inventory of geospatial wetland data. This standard is of significance to the NERR System which will be mapping wetland areas. FGDC protocols require vector data output derived from 1:12,000 scale (or less desirable 1:24,000) with source data at 1-m resolution (1:63,360 at 5m for Alaska) to have (1) 68% positional accuracy within 5-m on the ground, (2) 98% producer's accuracy (error of omission) in delineating wetland areas from non-wetland areas, and (3) 85% attribute accuracy (correct wetland classification). Source data can be aerial photography or satellite imagery. These standards will apply to the NERRS mapping standards for mapping wetlands produced with federal dollars.

Achieving the FGDC Wetland Subcommittee standards and conducting the associated accuracy assessments for wetlands is highly recommended for reserve system maps uploaded to the CDMO. However, conducting these assessments may be beyond the resource capability of the reserves. Therefore, the NERRS will commit to conducting such an assessment at the reserve system level through an automated process. All maps submitted within a given year will be included in a system-wide accuracy assessment to ensure compliance with the FGDC mapping standard. The resulting accuracy assessment will be attached to the metadata of shapefiles submitted by reserves whose data was included in the accuracy assessment. Associated read-me files will be amended accordingly as well.

Registration error, resulting from misalignment or distortion in the imagery, generates false differences during change detection. Therefore an estimate of the source imagery's spatial accuracy must also be included in the accuracy assessment. Commercial vendors of orthorectified satellite and aerial imagery typically provide such an assessment. If the spatial accuracy of the source imagery is unknown (e.g. locally georeferenced aerial photography), a sampling procedure that compares points visible on the imagery with their "true" reference positions should be performed. A spatial accuracy assessment that uses Global Positioning System (GPS) and, if available, high spatial accuracy reference imagery should be reported using a Root Mean Square Error (RMSE) and an associated 95% confidence interval for the horizontal coordinates (x,y) (Congalton and Green, 2009). It is important to understand that reference imagery and GPS coordinates will have their own sources of error and therefore a sufficient number of reference positions need to be collected to derive a meaningful estimate for the RMSE of an image product.

## 1. Accuracy Assessment Matrix

At a minimum, the accuracy assessment analysis will involve the collection of *in situ* reference data with a real time corrected Global Navigation Satellite System (GNSS) or Global Positioning System (GPS) unit capable of real time positioning ( $\pm 10$  feet). In areas of perpetual interest, each field point will be classified to the subclass level in accordance with the NERR habitat and mapping classification system. This reference dataset will be used to create an error matrix that ranks the number of test samples assigned to each land cover class against their "correct" assignments as verified through the reference data. (Congalton and Green, 2009).

The matrix will provide producer accuracy (errors of omission – due to missing data) and user accuracy (errors of commission – due to misclassification) for the classification level of interest within the habitat dataset. An un-weighted Kappa statistic coefficient must also be computed (Congleton and Green, 2009). This statistic will compare the results of the reference dataset and the classified imagery at either the class or sub-class level of the habitat classification scheme depending on the purpose of the map.

The reference dataset must also be used to define the accuracy of priority areas/habitats selected by individual reserves. A second Kappa statistic must be created to compare the accuracy of the classification of each area/habitat of perpetual interest to all others. The reference dataset should be submitted to the CDMO as a point shapefile with associated metadata that includes a column indicating date and time the field site was visited (YYYY-MM-DD HH:MM:SS) and a hyperlink to ground photography for each site. Photographs should be stored in jpeg format and follow the format listed in the **Standardized Naming Scheme for all Data Products Submitted to CDMO (see below)**. The dataset used to validate accuracy assessment should not be used in the initial classification of the habitat dataset (i.e., training).

The following figures provide examples of the Kappa statistic equation (Figure 1), error matrices for habitats classified to the class and sub-class level (Figures 2 and 3 respectively), and the computation of a Kappa statistic (Figure 4).

Figure 1. Kappa statistic equation (adapted from Sim & Wright, 2005). Chance agreement refers



to the proportion of agreement expected to occur by chance.

(a) Kappa statistic equation:

$$K = \frac{\text{observed agreement} - \text{chance agreement}}{1 - \text{chance agreement}}$$

(b) Kappa statistic equation in terms of symbols:

$$K = \frac{P_o - P_c}{1 - P_c}$$

**Figure 2. Example accuracy assessment matrix at the class level. Note that white cells represent agreement between the classified imagery and the validation dataset; grey represents disagreement.**

GIS MAP	Reference				Total
	2210. Aquatic bed	2230. Streambed	2260. Emergent wetland	2560. Scrub-shrub wetland	
2210. Aquatic bed	15	3	1	1	20
2230. Streambed	4	18	3	2	27
2260. Emergent wetland	4	5	16	4	29
2560. Scrub-shrub wetland	1	2	4	17	24
<b>Total</b>	<b>24</b>	<b>28</b>	<b>24</b>	<b>24</b>	<b>100</b>

**Figure 3. Example accuracy assessment matrix for seagrass habitat (sub-class) (Lathrop et al., 2006). Can we change or add the reserve system nomenclature at the sub-class level (rooted vascular (2133)**

GIS Map	Reference		User's Accuracy
	Seagrass Absent	Seagrass Present	
Seagrass Absent	67	32	68%
Seagrass Present	10	136	93%
Producer's Accuracy	87%	81%	83%

**Figure 4. Calculation of Kappa statistic (K) using data from Figure 2.**

$$\text{observed agreement } (P_o) = \frac{\text{sum of diagonal}}{\text{sum of matrix}} = \frac{15 + 18 + 16 + 17}{100} = \mathbf{0.66}$$

$$\text{chance agreement } (P_c) = P_1P_1 + P_2P_2 \dots = [(24/100)*(20/100)] + [(28/100)*(27/100)] + [(24/100)*(29/100)] + [(24/100)*(24/100)] = \mathbf{0.25}$$

$$K = \frac{P_o - P_c}{1 - P_c} = \frac{0.66 - 0.25}{1 - 0.25} = \mathbf{0.55 \text{ (moderate agreement)}}$$

## 2. Methods for selecting reference data points

### i. Overall accuracy for the habitat classification dataset at the class level of the NERRS Habitat Classification Scheme

When conducting the accuracy assessment, a stratified random sampling methodology is recommended for selecting reference points since it will help ensure that all classes of interest are accounted for in the accuracy assessment. However, this type of sampling design might not be possible where information on class spatial distribution is unknown prior to field work (see Congalton and Green, 2009 for a complete description of reference site selection). We recommend a subset of classified polygons be selected as *in situ* reference sites. A polygon should not contain more than one x,y coordinate pair, and a minimum of 100 coordinate pairs should be randomly selected from inside the study area (i.e., 100 polygons with one point in each polygon). Depending on when reference sites are visited (i.e., pre, during, or post imagery collection), different site selection strategies may be required. Reference site selection should be both statistically valid and well documented in the attached metadata.

Researchers collecting data in the field should be aware of potential issues caused by the GPS data and/or errors in the spatial position of the source imagery. Care should be taken to ensure that the correct polygon is assigned to the correct reference site. This error can be minimized by using the highest accuracy GPS unit available, collecting GPS data during periods of low PDOP (Dilution of Precision), and minimizing the spatial errors of the initial source dataset. The accuracy of the GPS unit used for reference site selection should be noted in the description of the methodology of the accuracy assessment.

### ii. Overall accuracy for the habitat classification dataset at the sub-class level of the NERRS Habitat Classification Scheme for Areas/habitats of Perpetual Interest

For areas/habitats of perpetual interest, a minimum of fifty *in situ* reference points should be collected. Fifty samples per sub-class is a general rule of thumb for the minimum sample size needed to assess the accuracy of a specific sub-class (Congalton and Green, 2009). However, this will most likely not be possible for maps including multiple habitat classes and sub-classes due to the time and cost of collecting reference site information.

## IV. Change Analysis

Since the HMC Plan recommends the use of conventional photo-interpretation of areas/habitats of perpetual interest whenever possible, change analysis can be conducted by laying the baseline (original) vector layer over the new source data and manually modifying polygons and attributes to reflect actual changes in the landscape in a systematic manner. Across a ten-year

cycle, stable-habitat polygons will remain unchanged and dynamic habitats or those under anthropogenic or climate-related stress will require classification or boundary changes. The method used to conduct the change analysis must be described in the metadata.

## V. Submission to CDMO

### A. Organizational Structure

The HMCTC will become a sub-committee of the System-Wide Monitoring Program (SWMP) Data Management Committee (DMC). The key priorities of this sub-committee are to ensure Quality Assurance/Quality Control (QA/QC) compliance with the standards established by the HMC Plan, provide technical assistance, set yearly priorities, and revise the SOPs as necessary. Specifically, the role of this sub-committee will be to:

- Provide technical assistance to reserves in support of mapping and elevation strategies.  
The committee will support the mapping community by assessing and coordinating training for all aspects of mapping including implementation of the NERR classification scheme, change analysis, accuracy assessments, etc. Committee members will also assist reserves in specific mapping needs.
- Ensure that all map products submitted to the CDMO comply with the standards established by the HMC Plan and referenced in this SOP.  
The committee will review all data products submitted by reserves to ensure that it has FGDC compliant metadata, attribute tables, and appropriate projections, scales, imagery resolution, nomenclature, accuracy assessments, etc. If a map product does not comply with the requirements of the plan, it will be returned for editing. No mapping product will be forwarded to the CDMO that does not meet the standards identified in the HMC Plan SOPs.
- Provide leadership to improve coordination within the NERR mapping community to identify and address emerging needs and issues.  
The committee will address emerging needs and issues that relate to mapping. This will include such responsibilities as adoption of new mapping protocols and standards by the FGDC and NOAA. The committee will be responsible for updating any new adopted protocols/standards in these SOPs. The committee will also identify methods for streamlining access to data and enhancing integration within the NERR mapping community. Finally, this committee will establish system-wide priorities that lead to the yearly development of action plan and/or strategic proposals to be submitted to the NERR Strategic Committee. In drafting these proposals, this committee will integrate to the maximum extent possible with the other DMC committees and the SWMP oversight committee.
- Monitor progress towards meeting annual operating plan goals.  
All reserves are required to develop baseline maps and change maps based on high resolution imagery every ten years, as identified in the NERRS three year annual

operating plan. The committee will be responsible for evaluating progress towards these goals and support reserves having difficulty meeting their goals.

- Improve integration with the other phases of SWMP.  
The Chair of this habitat mapping and change sub-committee will be represented on the SWMP oversight committee and will be responsible for overall coordination with the other SWMP sub-committees.
- Approve reserve Habitat Mapping and Change Plans.  
The committee will be responsible for reviewing all HMC Plans developed by individual reserves. The committee will also coordinate reviews by NOAA’s National Geodetic Survey and Center for Operational-Oceanographic Products and Services. Once all comments are addressed, the reserve’s HMC Plan will be approved by ERD. HMC Plan guidelines are detailed in Appendix A.

**B. Standardized Naming Scheme for all Data Products Submitted to the CDMO**

To facilitate the sorting and access of reserve data products on the CDMO website, all data products must be submitted using the following title format: **Reserve Code\_File Code\_Date Code\***. The specific codes are identified in Table 3 below.

\*Note: All C-CAP related data products must also include a tier code and should use the following title format: **Reserve Code\_File Code\_Tier Code\_Date Code**

**Table 3. Naming codes for Habitat Mapping and change data products.**

Reserve Name	Reserve Code
Ashepoo Combahee Edisto Basin, South Carolina	ACE
Apalachicola Bay, Florida	APA
Chesapeake Bay, Maryland	CBM
Chesapeake Bay, Virginia	CBV
Delaware	DEL
Elkhorn Slough, California	ELK
Grand Bay, Mississippi	GND
Great Bay, New Hampshire	GRB
Guana Tomalato Mantanzas, Florida	GTM
Hudson River, New York	HUD
Jacques Cousteau, New Jersey	JAC
Jobos Bay, Puerto Rico	JOB
Kachemak Bay, Alaska	KAC
Mission Aransas, Texas	MAR
Narragansett Bay, Rhode Island	NAR
North Carolina	NOC
North Inlet-Winyah Bay	NIW
Old Woman Creek, Ohio	OWC
Padilla Bay, Washington	PDB
Rookery Bay, Florida	RKB
San Francisco Bay, California	SFB

Sapelo Island, Georgia	SAP
South Slough, Oregon	SOS
Tijuana River, California	TJR
Waquoit Bay, Massachusetts	WQB
Weeks Bay, Alabama	WKB
Wells, Maine	WEL
File Type	File Code
Reserve Boundary	RB
C-CAP Land cover data	CCAPLC
C-CAP Change Analysis	CCAPCA
Impervious Surface	IMP
Canopy Cover	CAN
Digital Elevation Models	DEM
Digital Elevation Models of priority habitat - single priority area/habitat	DEMPH
Digital Elevation Models of priority habitat - multiple priority areas/habitats †	DEMPH_XX
High resolution priority habitat map - single priority area/habitat	HRLCPH
High resolution priority habitat map - multiple priority areas/habitats †	HRLCPH_XX
Change analysis of high resolution habitat - single priority area/habitat	HRCAPH
Change analysis of high resolution habitat – multiple priority areas/habitat †	HRCAPH_XX
High resolution habitat maps - outside of priority areas/habitats	HRLC
Change analysis of high resolution habitat maps – outside of priority areas/habitats	HRCA
Mapping Tier†	Tier Code
Reserve Boundary	RB
Estuarine Basin Boundary	EBB
Targeted Watershed Boundary	TWB
Small Watershed Boundary	SWB
Date	Date Code
Reserve Boundary - Year produced	YYYY
C-CAP Land cover data – Year imagery acquired	YYYY
Impervious Surface – Year imagery acquired	YYYY
Canopy Cover – Year imagery acquired	YYYY
Digital Elevation Models – Year elevations acquired	YYYY
Change Analysis – Original imagery year and New imagery year	YYYY_YYYY
High resolution maps – Month and year imagery acquired	YYYYMM

† Note: A two letter code will be used to denote specific priority areas or habitat types that have been mapped. For example, if all wetlands within the reserve were mapped as the priority habitat, the two letter code would be WL. If a specific geographic area was mapped, such as Redfish Bay, the code RB would denote the location of the mapping effort.

Examples case studies of standardized naming scheme:

- Elkhorn Slough NERR updates its reserve boundary in November of 2008 pursuant to new acquisitions. They submit their boundary file titled **ELK\_RB\_2008**.
- Narragansett Bay NERR submits a baseline map generated from high resolution land cover imagery collected in April of 2009 for the entire reserve. The map was submitted in November, 2009. They submit their shapefile titled **NAR\_HRLC\_200904**.

- Mission-Aransas NERR submits a baseline map of one of their four priority habitats (Redfish Bay) that is the target for habitat change analysis. The high-resolution imagery was collected in October 2008 and the map was submitted in June 2009. The shapefile is titled **MAR\_HRLCPH\_RB\_200810**.
- Narragansett Bay NERR submits a change analysis map of their reserve habitats based on new high resolution imagery acquired in April of 2014. The map was submitted in August 2014. The shapefile is titled **NAR\_HRCA\_2008\_2014**.
- Mission-Aransas NERR submits a change analysis map of one of their four priority habitats (Redfish Bay) based on new high resolution imagery acquired in October 2013. The map was submitted December 2013. The shapefile is titled **MAR\_HRCAPH\_RB\_2008\_2013**.
- Ace NERR submits their C-CAP change analysis for their estuarine basin from year 1997 to 2001. The file is titled **ACE\_CCAPCA\_EBB\_1997\_2001**.

All high resolution shapefiles must be accompanied by a “read me” file that describes the geographic extent of the classification and the level of the classification (e.g., entire reserve classified to subclass level, priority habitats classified to subclass level, non-priority areas classified to class level). If more than one area/habitat of perpetual interest is mapped, the “read me” file must also include all two letter codes (e.g., Wetlands = WL, Redfish Bay = RB). Finally, the “read me” file should include any other descriptive and contextual information that will be useful to the viewer.

### *C. QA/QC Review process*

All files will be submitted to CDMO as a zipped file to an FTP site established by CDMO. A HMC GIS oversight committee representative will run an “Exploder” script that will automatically check the file to ensure that all the required files are attached, nomenclature is in the correct format, and that metadata is attached. When initial check is completed, the program will send an email to the representative that outlines the results of the check. If the files pass the initial screening process, the data will be unzipped and available for review by the HMC GIS oversight committee representatives. If there are problems with the files identified by the automated review process, an oversight representative will notify the designated reserve staff and request that the errors be corrected and re-submitted.

Once the files have been approved by the automated review process, The HMCTC oversight representatives will conduct a secondary QA/QC review of the files to determine if they meet the standards established by the SOPs for standards and FGDC metadata requirements. The HMCTC oversight representatives will check for the following

- The metadata attached to shapefiles are FGDC compliant and adhere to the minimum

mapping standards and procedures identified in the SOPs,

- Accuracy assessments are complete with assessment matrices and kappa statistics attached in the metadata and jpeg images of groundtruthing sites are included with the appropriate naming conventions.
- Correct classification nomenclature conventions were used in the attribute tables and that attribute tables have the columns that represent the minimum standards identified in the SOP's.
- Once the files are determined to be in compliance, an oversight representative will execute a "distribution" function that will upload the files to their appropriate location on the CDMO server to be available for public access. The CDMO web site will automatically translate the shapefiles into Google Earth files.

## Literature Cited

- Cohen, J. (1960). A coefficient of agreement for nominal scales. *Education and Psychological Measurement* **20**: 37-46.
- Congalton, R., and Green, K. (2009). *Assessing the Accuracy of Remotely Sensed Data: Principles and Practices, Second Edition*. CRC Press. Boca Raton, FL.
- Dobson, J.E., E.A. Bright, R.L. Ferguson, D.W. Field, L.L. Wood, K.D. Haddad, H. Iredale III, J.R. Jensen, V.V. Klemas, R.J. Orth, and J.P. Thomas, 1995. NOAA Coastal Change Analysis Program (C-CAP): guidance for regional Implementation.
- Kutcher T. Garfield, N. Van Dyke, E.Schull, S. Walker, S., Herold, N. Scott, G. Hensel, P, Allen, A.. 2008, "SWMP Phase III: Land Use, Land Cover, and Habitat Change" Report for the National Estuarine Research Reserves Division. NOAA/NOS/OCRM/ERD. NERRS.NOAA.GOV
- Lathrop, R., Montesano, P., and Haag, S. (2006). A Multi-scale Segmentation Approach to Mapping Seagrass Habitats Using Airborne Digital Camera Imagery. *Photogrammetric Engineering & Remote Sensing* **72**: 665-675.
- Nieder C. Porter, D. Rumrill, S. Wasson, K. Wenner, E. Stevenson, B and Treml, 2002. "Land Use and Land Cover Change Analysis in the National Estuarine Research Reserve System. Report Prepared for the National Estuarine Research Reserve System.
- Sim, J., and Wright, C. (2005) The Kappa Statistic in Reliability Studies: Use, Interpretation, and Sample Size Requirements. *Physical Therapy* **85**: 257-268.
- SWMP revision, 2007. THE NATIONAL ESTUARINE RESEARCH RESERVE'S SYSTEM-WIDE MONITORING PROGRAM (SWMP): A SCIENTIFIC FRAMEWORK AND PLAN FOR DETECTION OF SHORT-TERM VARIABILITY AND LONG-TERM CHANGE IN ESTUARIES AND COASTAL HABITATS OF THE UNITED STATES (2002; Revised August 2007). Available at <http://nerrs.noaa.gov>
- Walker, S.P. and N. Garfield. 2006. Recommended guidelines for adoption and implementation of the NERRS comprehensive habitat and land use classification system. Report for the Estuarine Reserves Division, NOAA/NOS/OCRM, Silver Spring, MD, NERRS.NOAA.GOV.



## **Appendix A: HMC Plan Guidelines**

Forthcoming

## **Appendix B: Methodology for Mapping Habitat Change - forthcoming**

**Old Woman Creek NERR  
Management Plan**

**APPENDIX T**

**Consistency Determination, Ohio Office of  
Coastal Management, January 2009**



# Ohio Department of Natural Resources

450

TED STRICKLAND, GOVERNOR

SEAN D. LOGAN, DIRECTOR

OFFICE OF COASTAL MANAGEMENT  
105 WEST SHORELINE DRIVE  
SANDUSKY, OHIO 44870  
(419) 626-7980  
FAX (419) 626-7983

January 20, 2009

Frank Lopez, Manager  
Old Woman Creek NERR  
ODNR Division of Wildlife  
2514 Cleveland Road, East  
Huron, Ohio 44839

RE: Draft *Management Plan 2009-2013* for Old Woman Creek NERR

Dear Mr. Lopez:

The Ohio Department of Natural Resources (ODNR) has completed a Federal Consistency review of the above referenced project. According to the information you provided, the plan contains the collective vision, mission, goals, and objectives of the Old Woman Creek National Estuarine Research Reserve (NERR) and establishes policies for the sustainability of the natural resources for the maintenance of the ecological balance of the Reserve.

The Coastal Zone Management Act and its corresponding federal regulations provide that any federal agency activity affecting any coastal use or resource of a state's designated coastal zone must be conducted in a manner consistent to the maximum extent practicable with the enforceable policies of that state's approved coastal management program. ODNR is the designated state agency under the Ohio Coastal Management Program. As such, ODNR is responsible for concurring with or objecting to federal agency consistency determinations.

This letter is to inform you that ODNR concurs with your Federal Consistency determination. No further coordination with this office regarding this Federal Consistency determination is necessary.

If you need additional information or have any questions regarding your consistency review, please feel free to contact me at (419) 626-7980.

Sincerely,

A handwritten signature in blue ink, appearing to read "Steve Holland".

Steve Holland, M.P.A.  
*Federal Consistency Coordinator*

c: John Watkins, P.E., Chief, Office of Coastal Management

OWC NERR Management Plan, 2011 - 2016



**Old Woman Creek NERR  
Management Plan**

**APPENDIX U**

**OWC NERR Visitor Center Display Design  
Concepts**

VISITOR EXPERIENCE & EXHIBITS  
CONSTRUCTION DOCUMENT PACKAGE

**DRAFT**

**OWNER:**

OLD WOMAN CREEK STATE NATURE PRESERVE & NATIONAL ESTUARINE RESEARCH RESERVE  
2514 CLEVELAND RD, EAST  
HURON, OH 44839  
T: 419.433.4601  
F: 419.433.2851

**EXHIBIT DESIGNER:**

RIGGS WARD DESIGN  
2315 W MAIN ST  
RICHMOND, VA 23220  
T: 804.254.1740  
F: 804.254.1742

**FABRICATOR:**

COLOR AD  
7200 GARY RD  
MANASSAS, VA 20109  
T: 703.631.9100  
F: 703.631.8749

**INTERACTIVE DESIGNER:**

POTION DESIGN  
265 CANAL ST  
SUITE 604  
NEW YORK, NY 10013  
T: 212.334.1222  
F: 212.898.0122

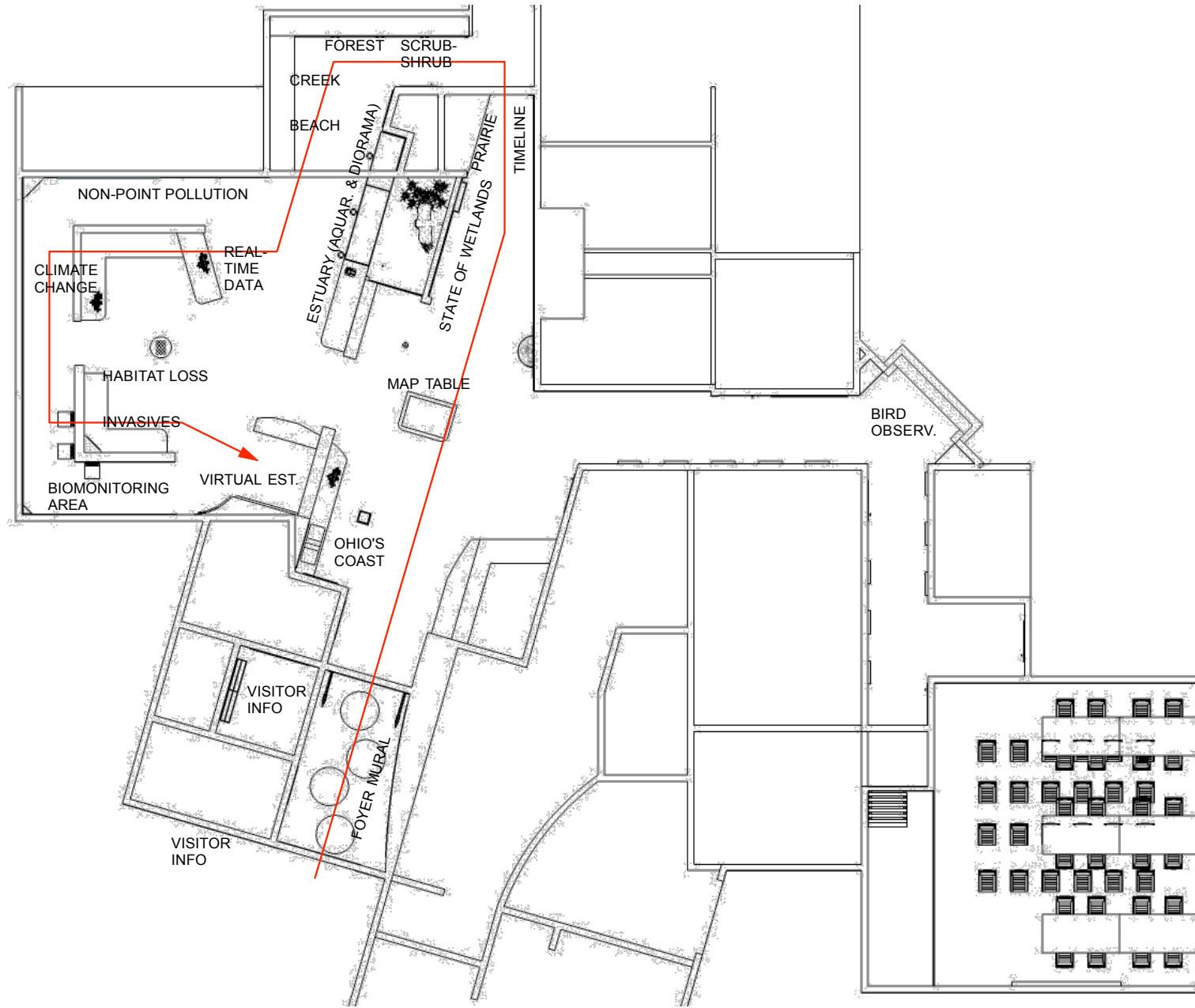
17 DEC 2010  
11 FEB 2011  
29 APRIL 2011

**COVER**  
OLD WOMAN CREEK NATIONAL ESTUARINE RESERVE  
OHIO DIVISION OF WILDLIFE

**INDEX:**

0.00	COVER	G.01	TYPE & COLOR SPECIFICATIONS
0.01	INDEX	G.02	EXAMPLE GRAPHICS
0.02	CONTENT OUTLINE & SPACE ALLOCATIONS	<del>G.03</del>	<del>OHIO'S COAST GRAPHICS</del>
0.03	NARRATIVE & RENDERINGS	<del>G.04</del>	<del>OWC TIMELINE GRAPHICS</del>
0.04	NARRATIVE & RENDERINGS	<del>G.05</del>	<del>STATE OF COASTAL WETLANDS GRAPHICS</del>
0.05	NARRATIVE & RENDERINGS	<del>G.06</del>	<del>PRAIRIE HABITAT GRAPHICS</del>
0.06	NARRATIVE & RENDERINGS	<del>G.07</del>	<del>SCRUB-SHRUB HABITAT GRAPHICS</del>
0.07	NARRATIVE & RENDERINGS	<del>G.08</del>	<del>FOREST HABITAT GRAPHICS</del>
0.08	NARRATIVE & RENDERINGS	<del>G.09</del>	<del>CREEK AND BEACH HABITATS GRAPHICS</del>
		<del>G.10</del>	<del>ESTUARY HABITAT GRAPHICS</del>
		<del>G.11</del>	<del>NON-POINT POLLUTION GRAPHICS</del>
		<del>G.12</del>	<del>CLIMATE CHANGE GRAPHICS</del>
		<del>G.13</del>	<del>HABITAT LOSS GRAPHICS</del>
		<del>G.14</del>	<del>INVASIVE SPECIES GRAPHICS</del>
1.01	DEMOLITION PLAN		
1.02	FLOOR PLAN		
2.01	ELEVATIONS		
2.02	ELEVATIONS		
2.03	ELEVATIONS		
2.04	ELEVATIONS		
2.05	ELEVATIONS		
2.06	ELEVATIONS		
3.01	GALLERY SECTIONS		
3.02	GALLERY SECTIONS		
4.01	PARTITIONS		
4.02	MAP TABLE		
4.03	HABITATS CASES		
4.04	ESTUARY DIORAMA & AQUARIUMS		
4.05	SCIENCE COUNTERS		
4.06	BIOMONITORING WALL		
4.07	VIRTUAL ESTUARY / OHIO'S COAST		
5.01	SCALED ARTIFACTS		
5.02	SCALED ARTIFACTS		

17 DEC 2010  
11 FEB 2011  
29 APRIL 2011



**CONTENT OUTLINE:**

**I. ORIENTATION & INTRODUCTION**

- I.A) Features of Lower Great Lakes Estuaries Mural
- I.B) Ohio's Coastal Resources
- I.C) Interactive Map Table

**II. EDUCATION**

- II.A) State of Coastal Wetlands
- II.B) Cultural History Timeline
- II.C) Aquariums and Habitats
  - II.C.1) Prairie
  - II.C.2) Scrub-Shrub
  - II.C.3) Forest
  - II.C.4) Creek
  - II.C.5) Estuary
  - II.C.6) Beach

**III. RESEARCH & STEWARDSHIP ("LABORATORY" AREA)**

- III.A) "Toy-like" Hands-On Interactive & Real-time Data displays
- III.B) "Laboratory" Area (*All areas in this section incorporate portions of "Meet the Scientist."*)
  - III.B.1) Nonpoint Pollution
  - III.B.2) Invasives
  - III.B.3) Habitat Loss
  - III.B.4) Climate Change
    - III.B.4.a) Weather Kiosk
- III.C) Virtual Estuary Interactive

**IV. OWC PROGRAMMING INFORMATION**

- IV.A) Movie Theatre (in classroom)
- IV.B) US Reserves Map & Photos
- IV.C) Photos and Info from past and current educational programs at OWC





BIRDS-EYE VIEWS



**FOYER & ENTRY HALLWAY:**

Scrim/fabric graphics of wildlife or scenery around the Reserve float above the heads of visitors as they enter the foyer. Existing wall cases drywalled in to create flat surface for mounting Great Lakes Mural in hallway and storage space on opposite side of wall. Wall and door of room opposite foyer mural removed to allow more space for visitors stopping to look at mural and easier access to changeable panels inside the room that display event and programming information.



**OHIO'S COASTAL RESOURCES:**

Sections of the two walls that currently create the corner opposite the reception desk removed to create a niche to house the Ohio's Coastal Resources exhibit. Interactive kiosk exists on a low counter that extends out into the gallery to hold related graphic interpretation and help guide visitors across the gallery to the Reserve map table and hallway exhibits.



**INTERACTIVE RESERVE MAP:**

On access with the overhead graphic banner that extends from the foyer hallway wall to the new wall behind the estuary diorama exhibit, an interactive map table floats in the center of the space to allow visitors and guide to circulate all the way around it.

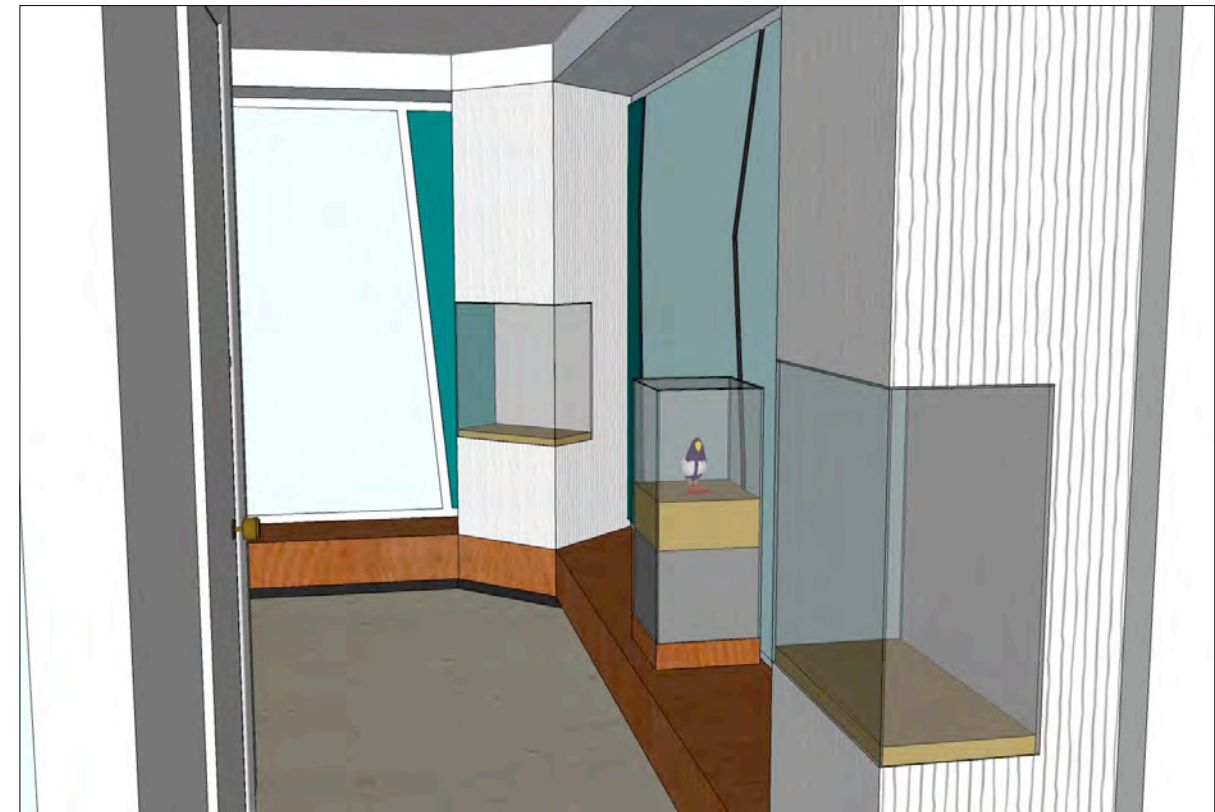


**STATE OF COASTAL WETLANDS & CULTURAL TIMELINE:**

The opposite face of the wall behind the estuary diorama holds graphics related to the State of Coastal Wetlands which introduce visitors to the key issues of the following exhibits. The first wall that visitors come to after entering the hallway exhibits is a timeline of the history of the estuary and how it has been affected by humans over time.

**NATURAL ENVIRONMENTS OF THE RESERVE:**

The main exhibits in this new hallway area are divided into five main sections. The content of each section relates to one of the natural environments found on the Reserve: prairie, shrub, wooded creek, estuary, and beach. These hallway exhibits make use of audio to add to the immersive experience. Project imagery could also be displayed on the floor of this area. The wall on which the shrub and wooded creek sections occur is also lined with three small aquariums which house fauna found in those natural ecosystems (snakes in the first tank, Box or Painted turtles in the second, and a taxidermy Passenger Pigeon in the third). The estuary exhibit is the largest of the five sections and is made up of three main components. The first of two aquariums holds deeper water fish species. The second aquarium holds shallow water, mussels, larger invertebrates, and possibly some amphibians. The third component of this section is a diorama of flora, terrestrial fauna, and bird species found in the estuary. This diorama is elevated behind the shallow water aquarium and backed by a tall pictorial wall. Along the two estuary aquariums, three interactive viewing scopes allow visitors can see microscopic life of the estuary. The viewing scope displays plant life. The second displays animal life. The third displays content which can be changed according to current issues and areas of research. A fourth interactive microscope allows visitors to view both microscopic plant and animal life simultaneously. Extending from the estuary section, a graphic counter displaying information about the Reserve's beach environment extends out into the main gallery toward the laboratory/research exhibits.





**LABORATORY / RESEARCH AREA:**

Through a series of counter-top displays and wall graphics, this section of the exhibit is related more directly the research done at OWC Reserve. Four main areas of concern are addressed (Habitat Loss, Climate Change, Nonpoint Pollution, Invasive Species). Each of these four areas include a short video (Meet the Scientist) and information related to research and stewardship relevant to its specific environmental threat/issue. Beginning this area of the exhibition, visitors are introduced to the research done at OWC Reserve through a display of real-time data representing each of the characteristics of water quality constantly being measured at the Reserve. In the center of this space, a hands-on interactive helps to further visitors' understanding of these water characteristics by making the relationships between each characteristic tangible.

**WILDLIFE OBSERVATION AREA:**

Between the new wall structures created to block sunlight coming in through the windows in the corner of the exhibit gallery and windows themselves, a recreated wildlife observation stand provides visitors with a chance to observe nature in a way similar to that which researchers observe it. A monitor displaying a webcam feed of the estuary is mounted up high between the windows. Below the monitor, field guides and other informational literature is available.



**VIRTUAL WATERSHED INTERACTIVE:**

At the end of the exhibition, a large interactive screen stands vertical on an exterior wall and allows visitors to role play, make decisions which affect the environment of the watershed according, and see the results of their decisions on the environment. On the wall adjacent to the interactive, a graphic explaining best management practices educates visitors so as to help them make the best real-life decisions they can in order to be better stewards of the watershed.



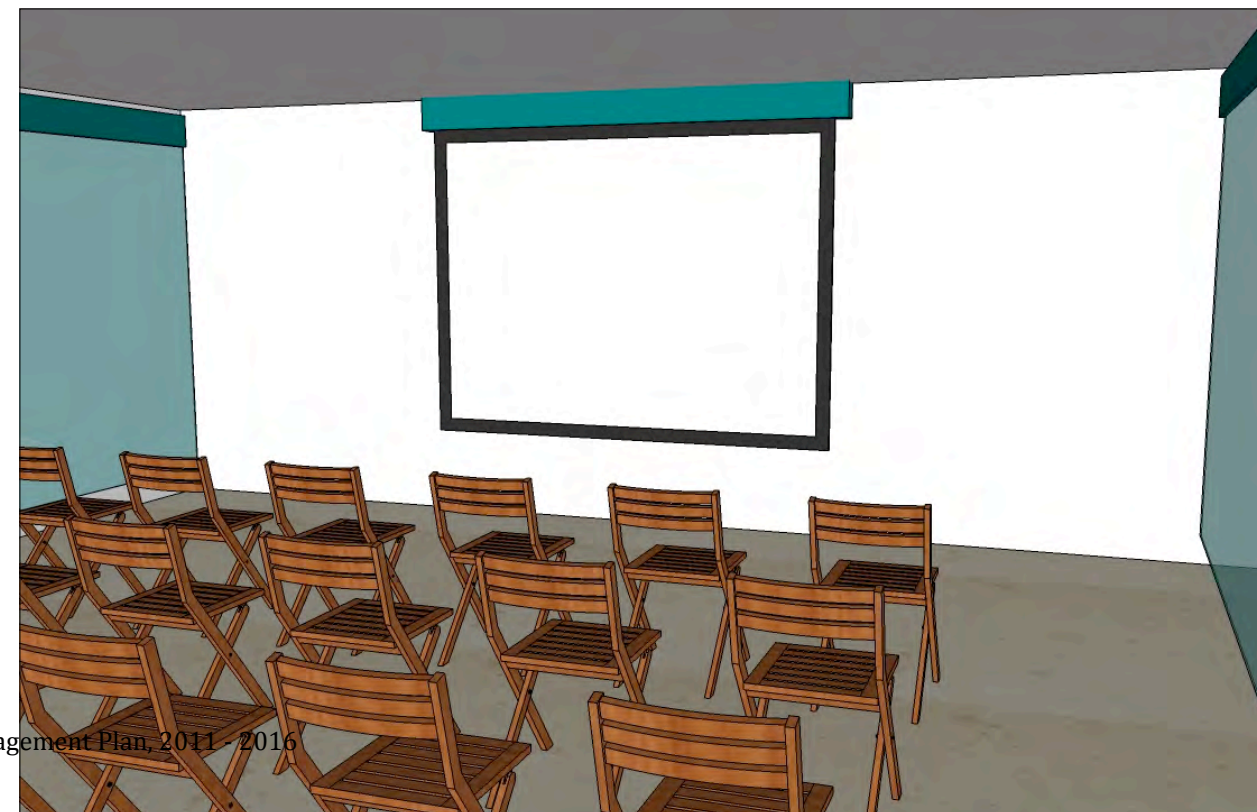
**HALLWAY TO CLASSROOM:**

In the hallway between the reception desk and the restrooms, visitors make their way to a map of reserves across the nation and a series of framed photos of other reserves. At the corner of the hallway, a bird observation area includes two small wall cases to either side of the windows and counter-top graphics which help visitor spot specific bird species. Following the hallway to the right past the observation windows, visitors come to an art gallery space displaying existing artwork and framed visitor photos of the Reserve.



**CLASSROOM / THEATER:**

The classroom is outfitted to convert into a theater space with a large retractable projection screen and two theater curtains that run the length of two opposite walls and help control light and sound in the space.



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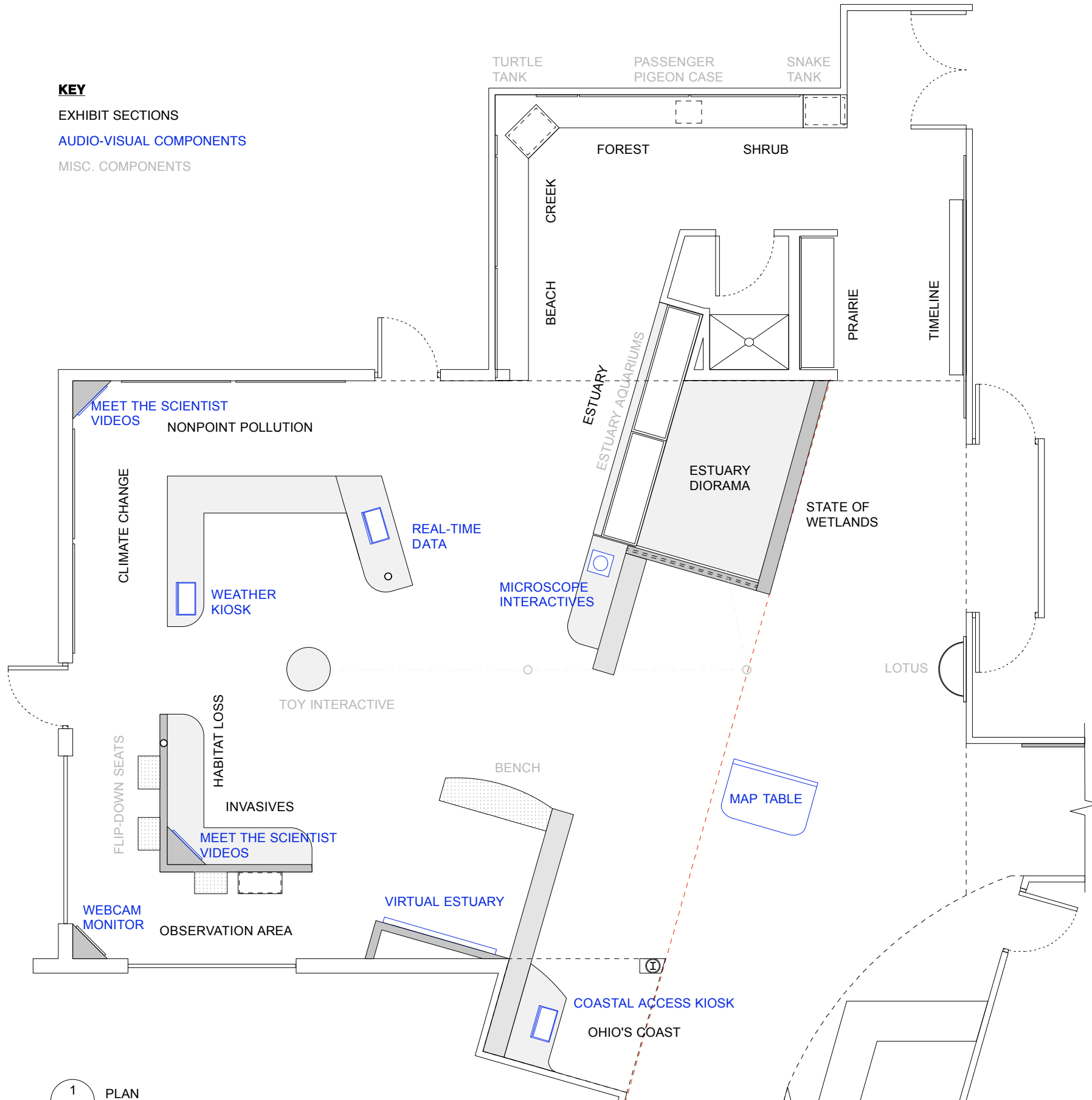
OWC NERR Management Plan, 2011 - 2016

**KEY**

EXHIBIT SECTIONS

AUDIO-VISUAL COMPONENTS

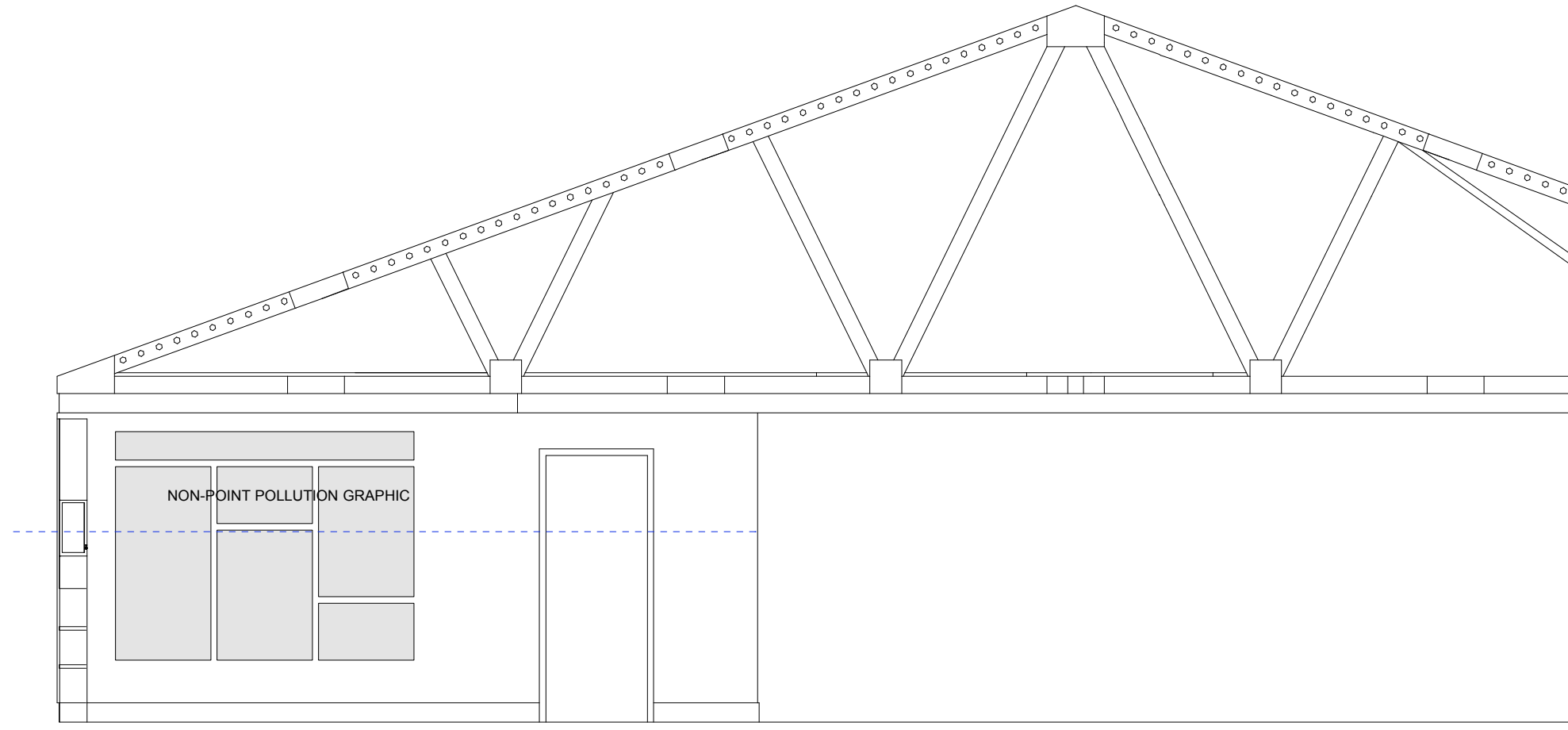
MISC. COMPONENTS



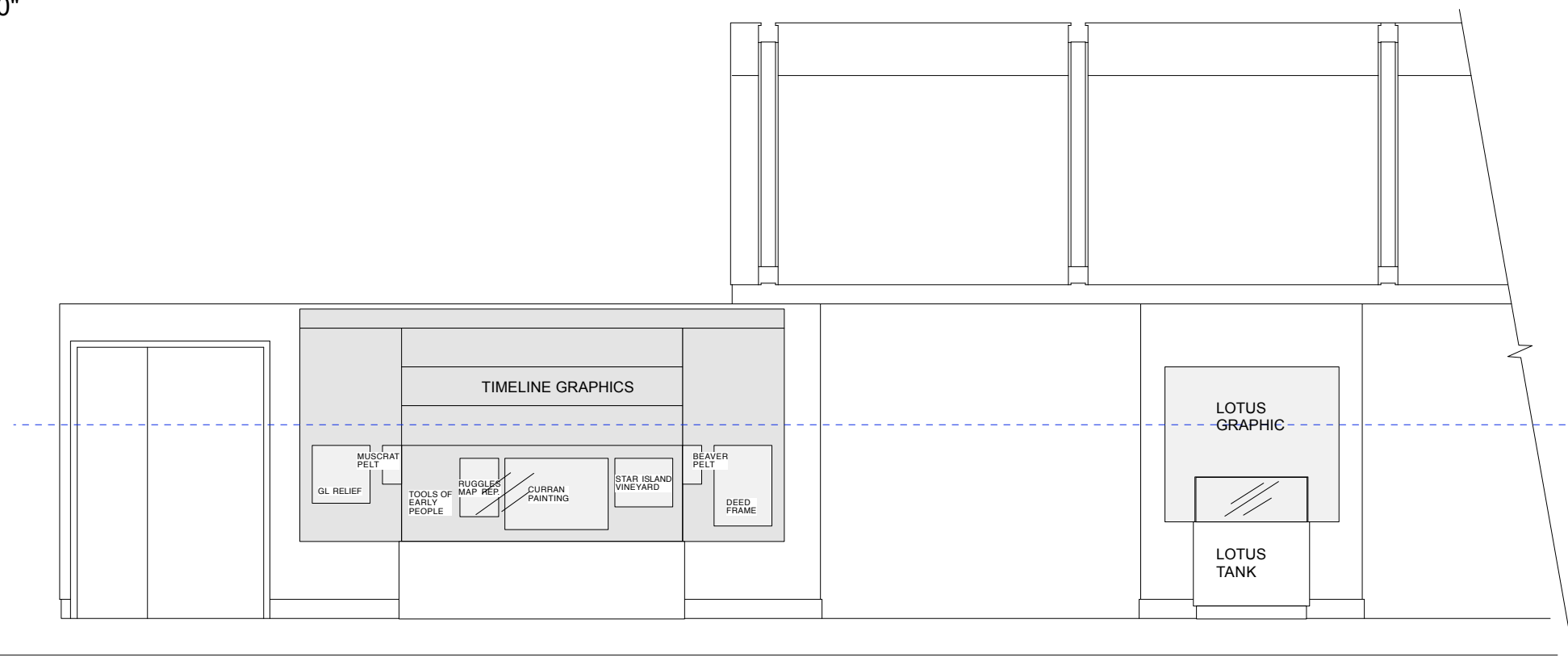
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OWC NERR Management Plan, 2011 - 2016

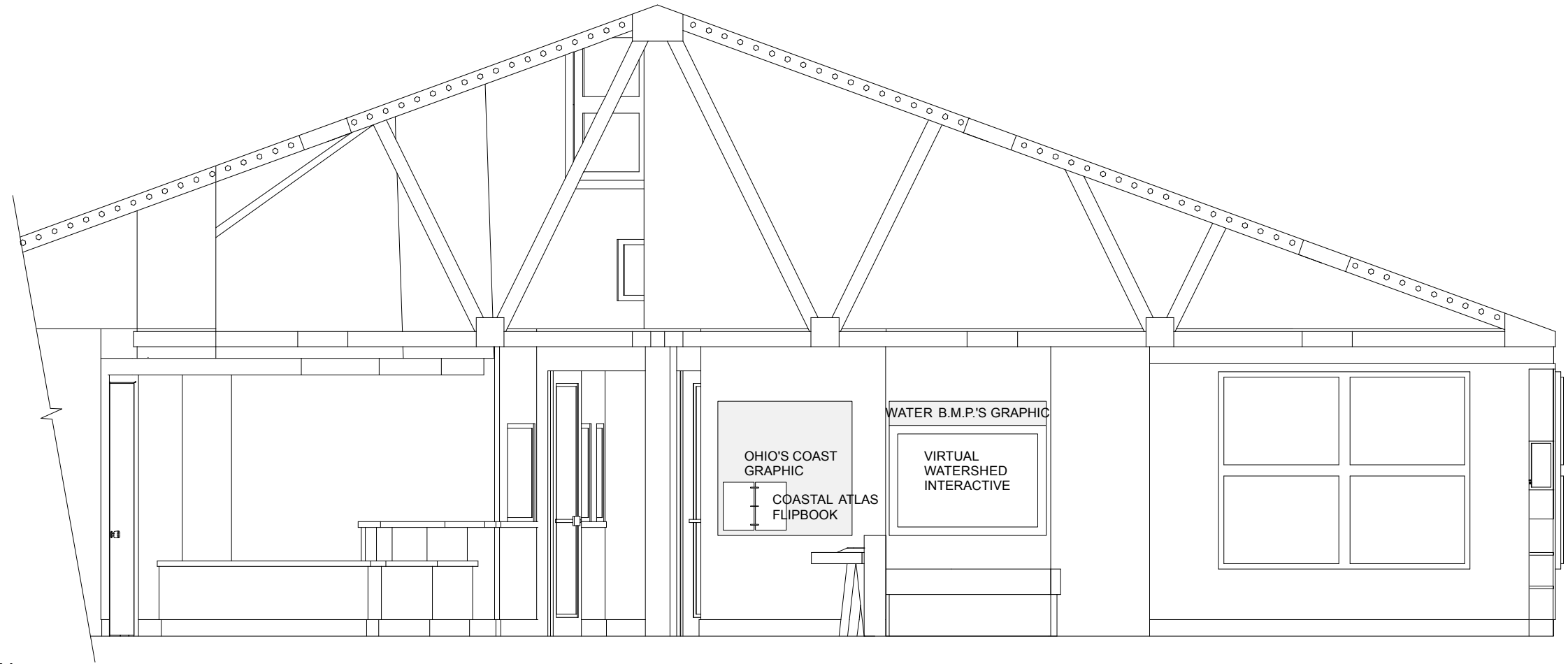




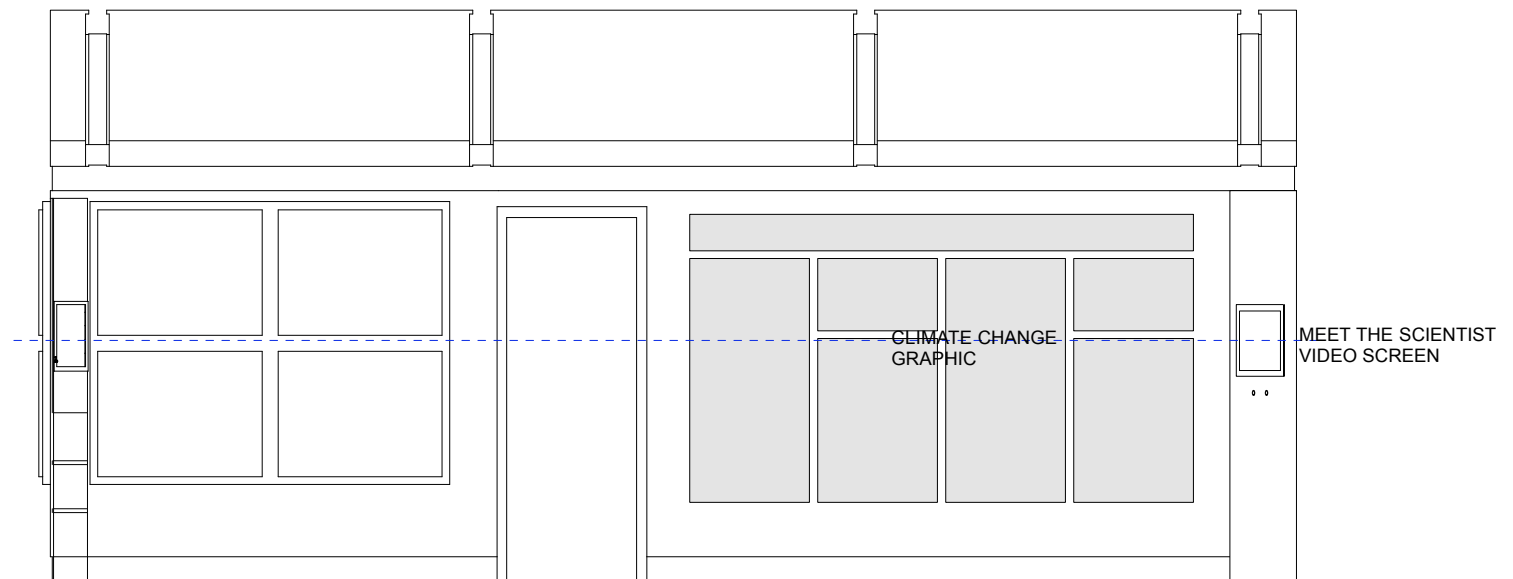
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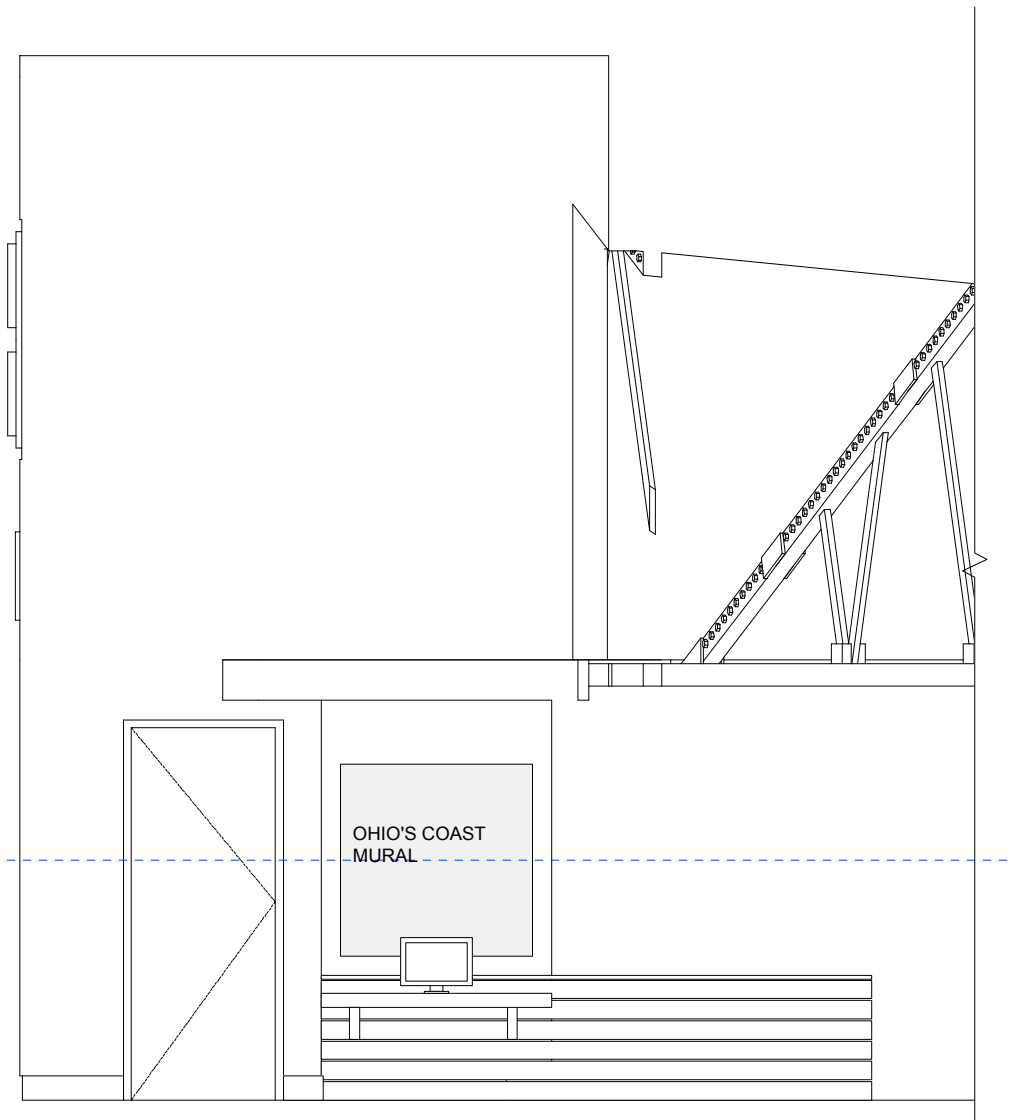
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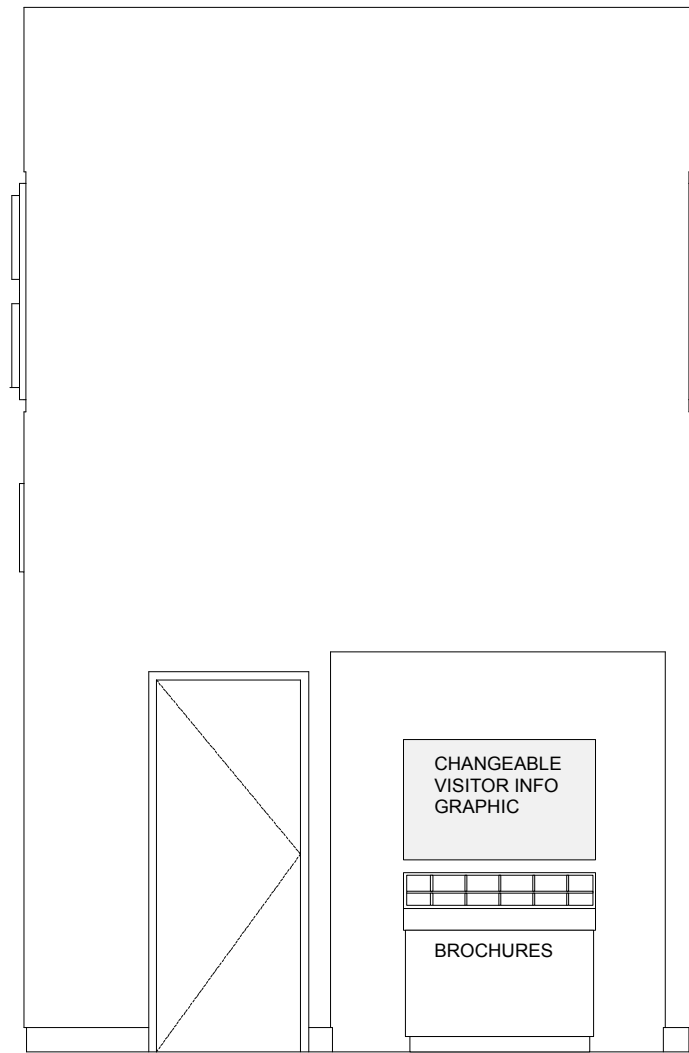
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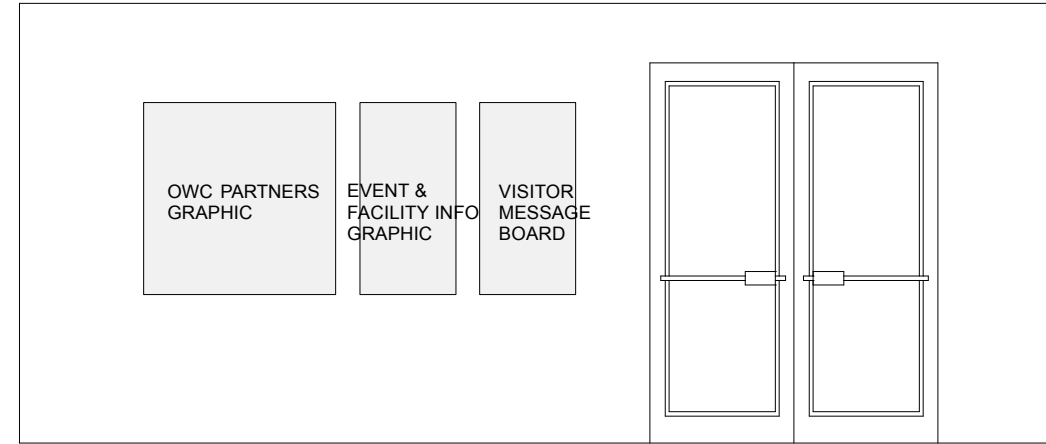
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OWC NERR Management Plan, 2011 - 2016



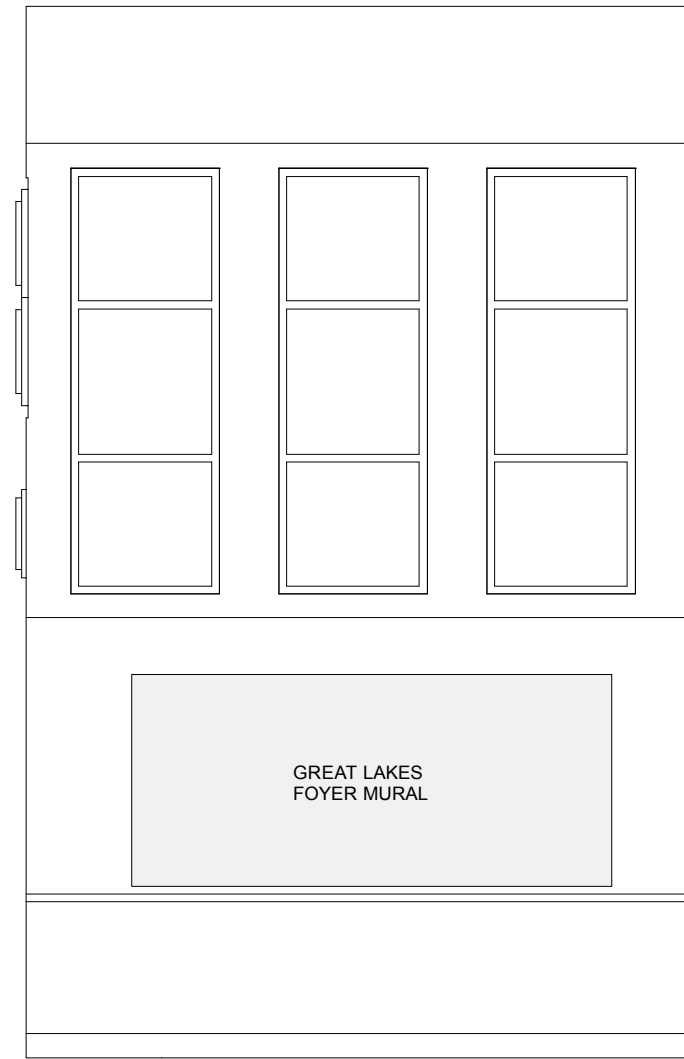
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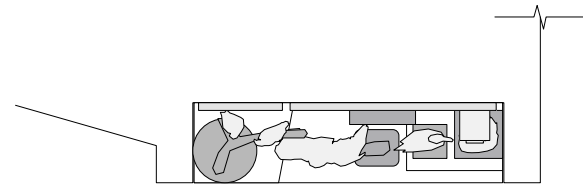
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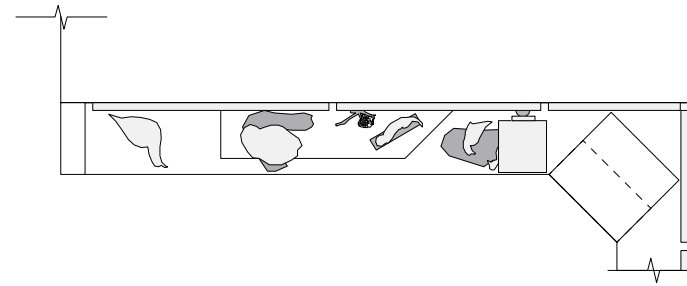
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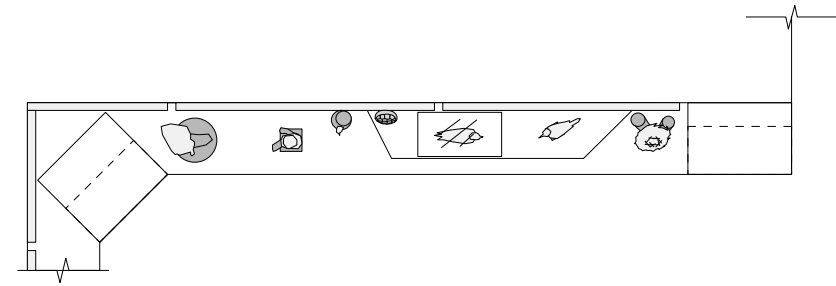
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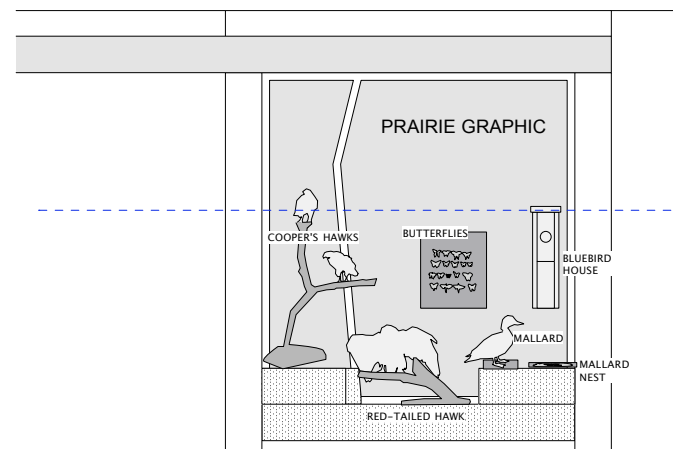
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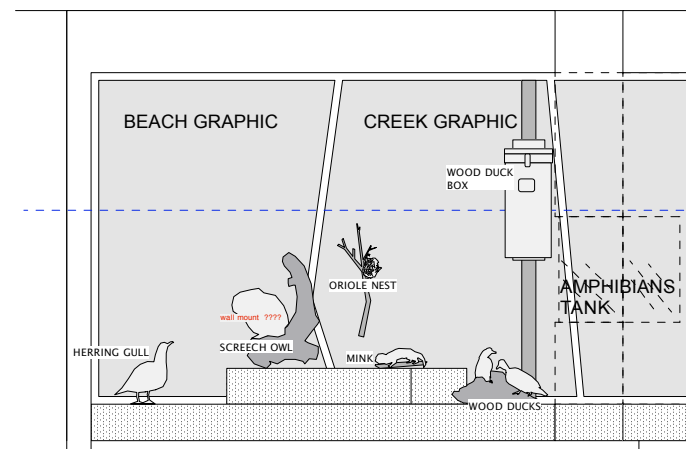
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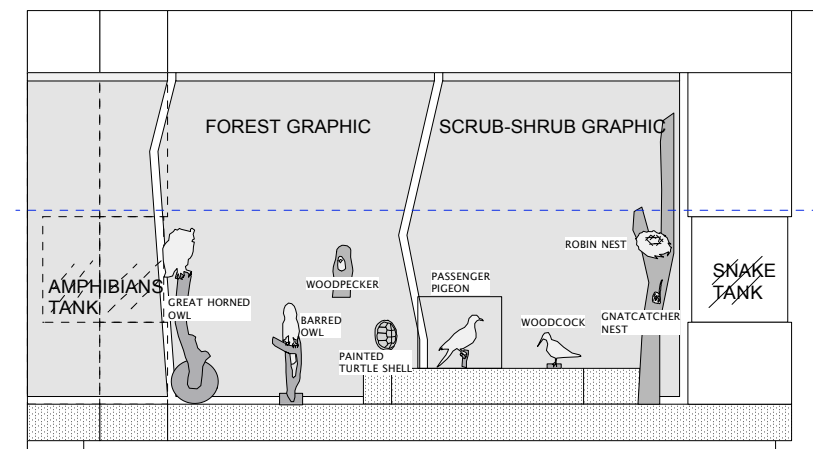
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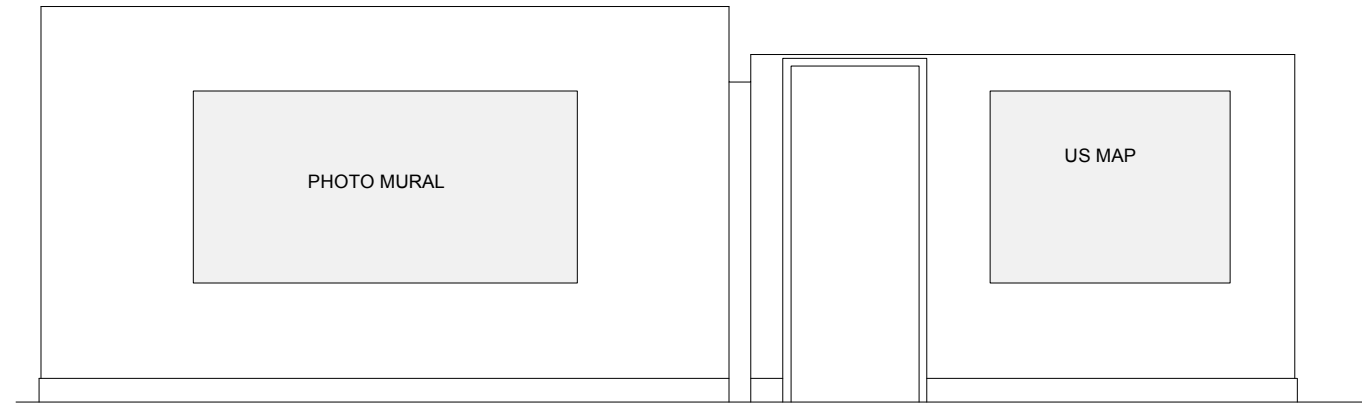
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OWC NERR Management Plan, 2011 - 2016



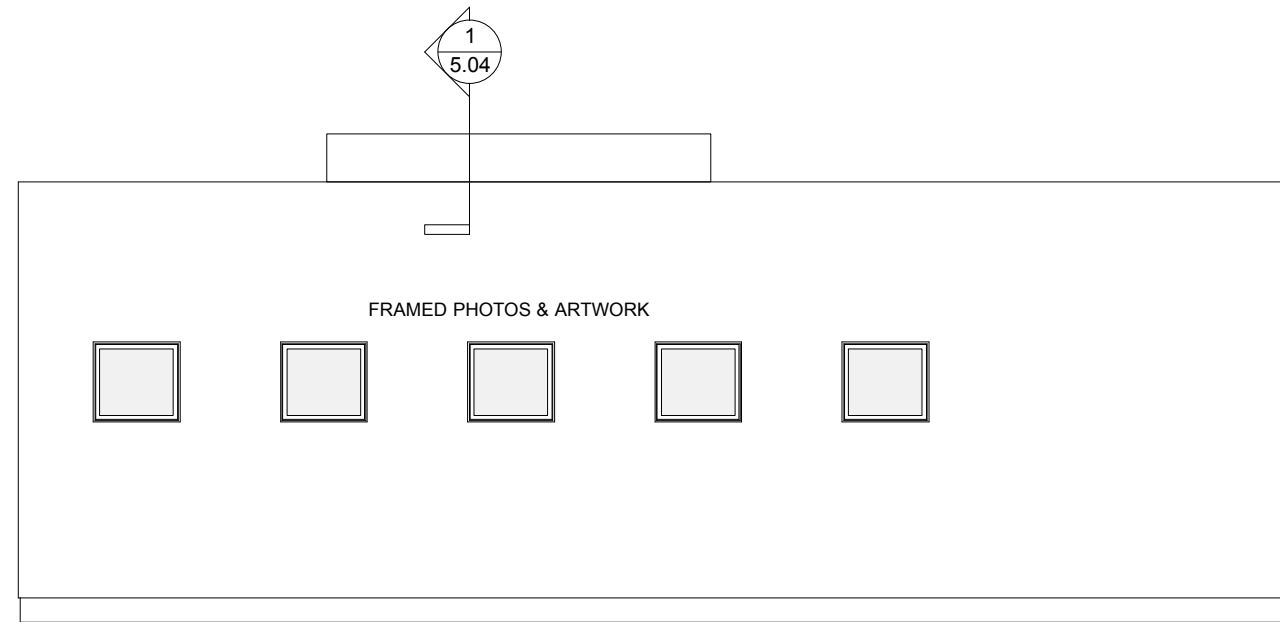
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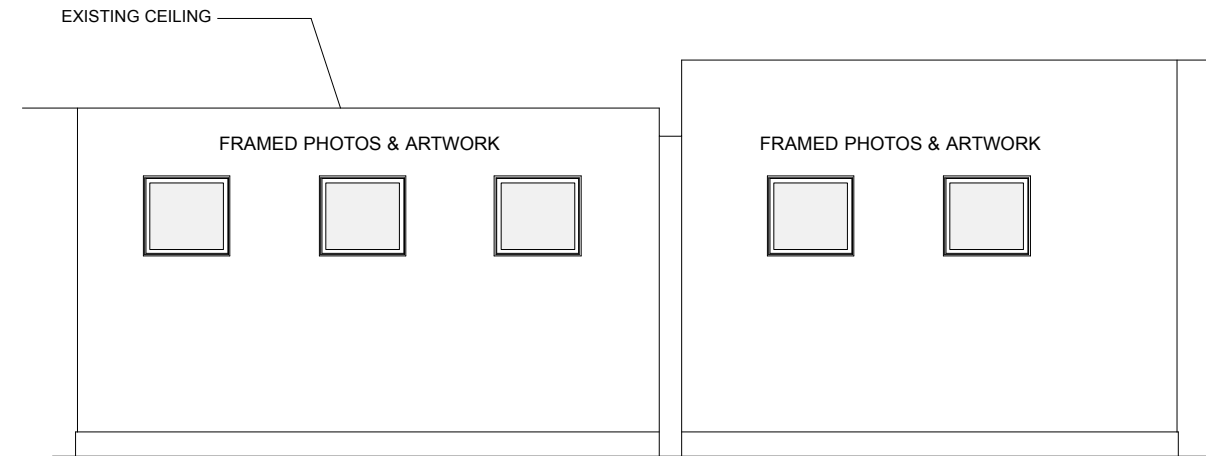
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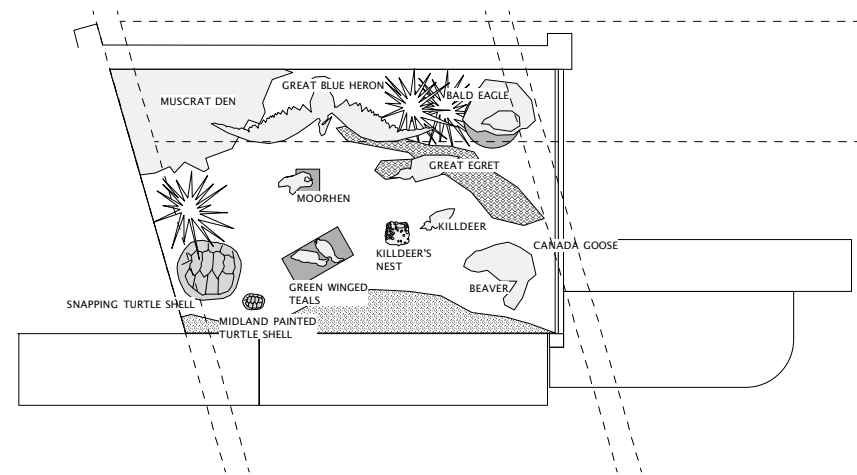


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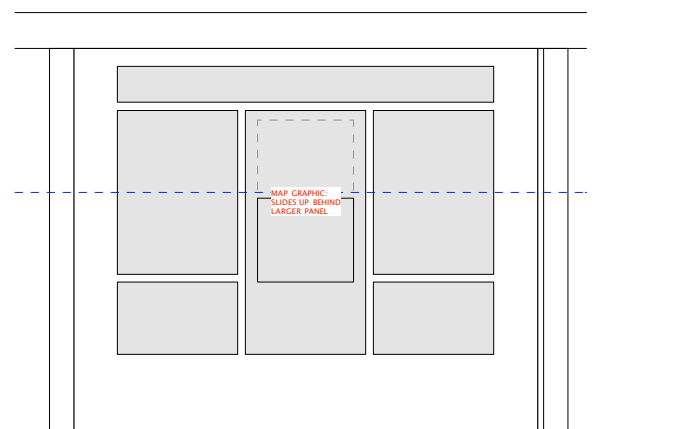


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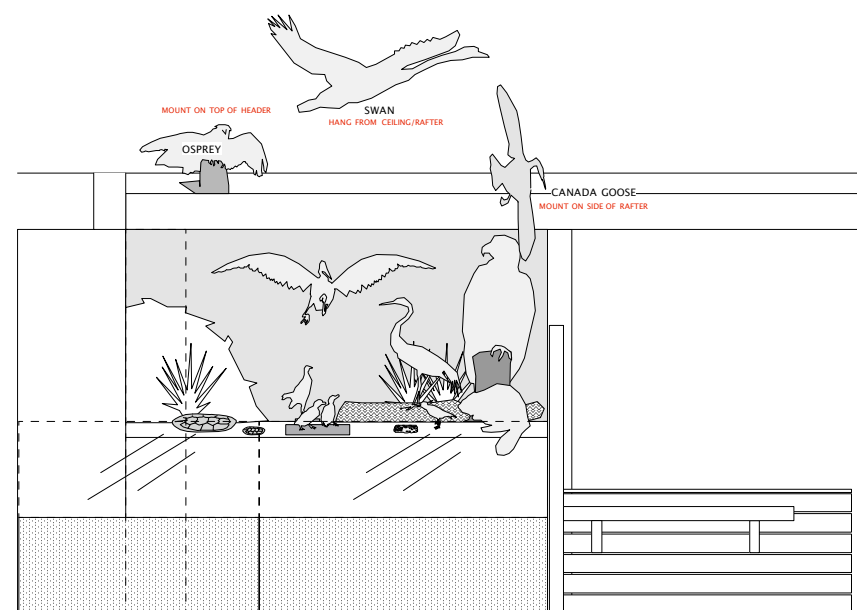
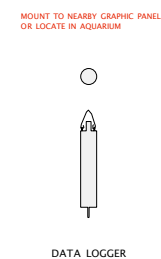
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1 PLAN  
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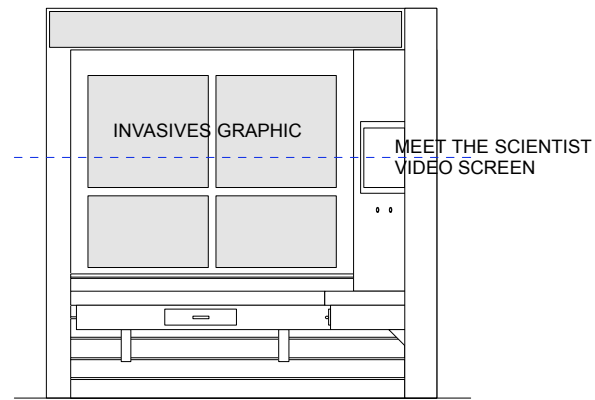
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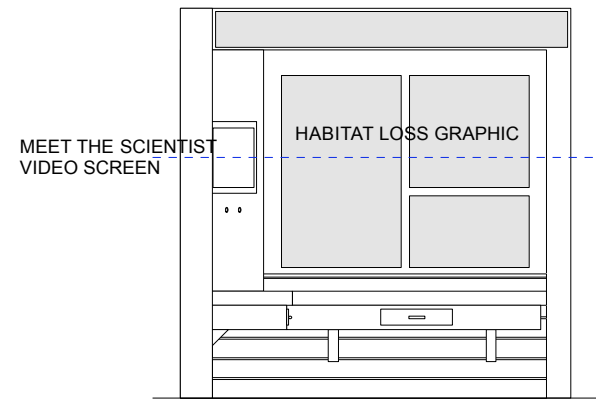
1 INTERIOR ELEVATION  
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**ELEVATIONS**  
OLD WOMAN CREEK NATIONAL ESTUARINE RESERVE  
OHIO DIVISION OF WILDLIFE



1 ELEVATION  
- SC: 1/4" = 1'-0"



2 ELEVATION  
- SC: 1/4" = 1'-0"

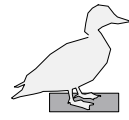
OWC NERR Management Plan, 2011 - 2016



PRAIRIE SECTION



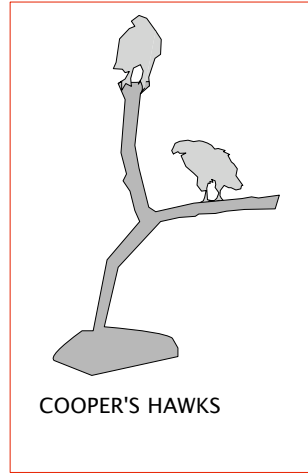
MALLARD NEST IN WOODEN BOX



MALLARD

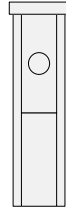


BUTTERFLY MOUNT BOX

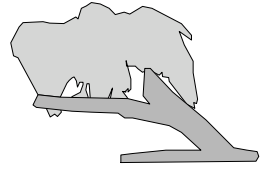


COOPER'S HAWKS

WALL MOUNT



BLUEBIRD HOUSE



RED TAILED HAWK

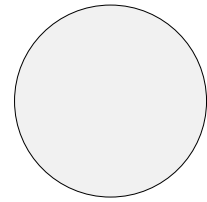
SHRUB SECTION



WOODCOCK



AMERICAN ROBIN NESTS



OWC WATERSHED SIGN

MOUNT ONTO BRANCH



GNATCATCHER NEST ON TWIG

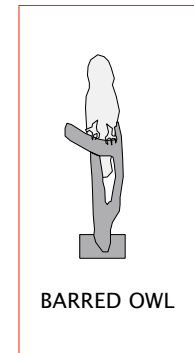
PASSENGER PIGEON

MOUNT ???  
MUST BE IN CASE

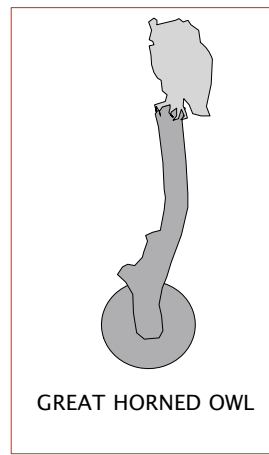


PASSENGER PIGEON

SWAMP FOREST SECTION



BARRED OWL



GREAT HORNED OWL



ORIOLE NEST

WALL MOUNT



SCREECH OWL

WALL MOUNT ???

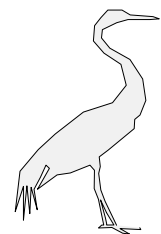
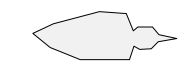


WOODEN WOODPECKER



BOX TURTLE SHELL

ESTUARY SECTION

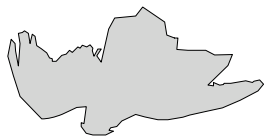
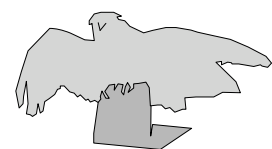


GREAT EGRET

mount ???



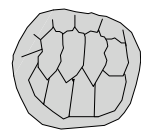
MINK



OSPREY



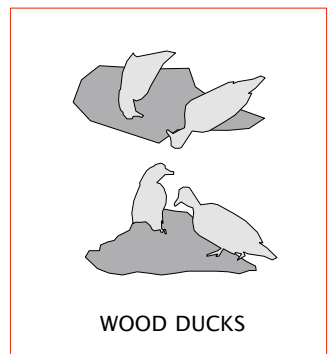
GREEN WINGED TEALS



SNAPPING TURTLE SHELL



MIDLAND PAINTED TURTLE SHELL



WOOD DUCKS

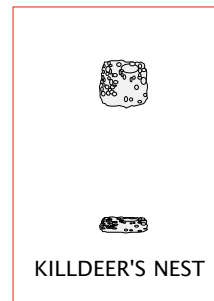


MOORHEN



BARN SWALLOW NEST

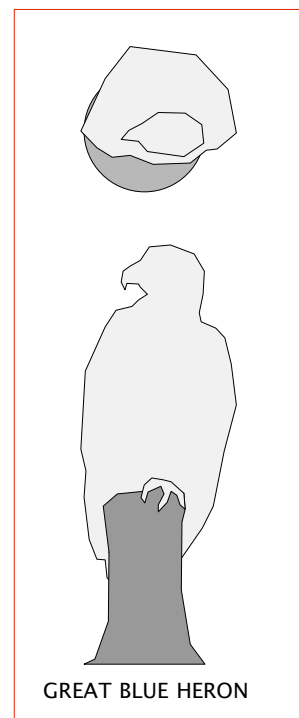
IS NEST SOLID SHAPE



KILLDEER'S NEST

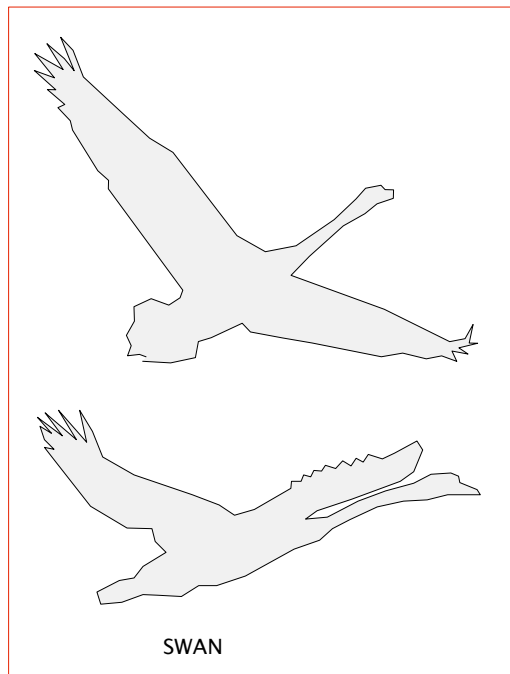


KILLDEER



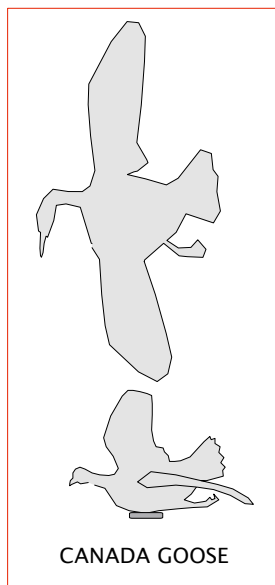
GREAT BLUE HERON

HANG FROM ABOVE



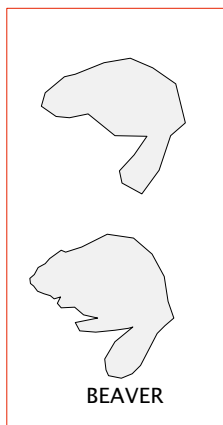
SWAN

WALL/RAFTER MOUNT



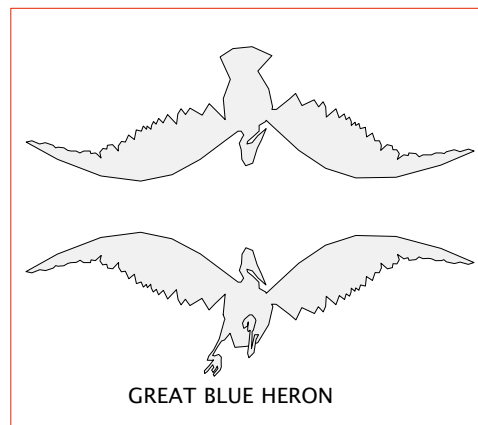
CANADA GOOSE

MOUNT ???



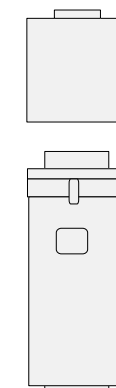
BEAVER

HANG FROM ABOVE



GREAT BLUE HERON

POLE-MOUNTED



WOOD DUCK BOX

IN AQUARIUM OR ON GRAPHIC WALL PANEL???

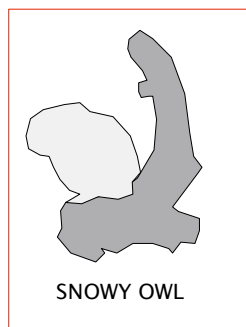


DATA LOGGER

BEACH SECTION



HERRING GULL



SNOWY OWL

# OLD WOMAN CREEK NATIONAL ESTUARINE RESERVE

ITC CHELTENHMAN

## HISTORY OF THE RESERVE

AKZIDENZ GROTESK MEDIUM

The Old Woman Creek National Estuarine Research Reserve (OWC NERR) was officially designated by NOAA in 1980. The Reserve is administered by the Division of Wildlife within the Ohio Department of Natural Resources. OWC NERR is the smallest Reserve in the national system, comprising 571 acres of protected lands and water along the southwestern shore of Lake Erie.

ITC CHELTENHMAN

## Changing Lake Levels

AKZIDENZ GROTESK MEDIUM

Unlike traditional marine estuaries where water level changes are generally predictable, water levels in the five Great Lakes are erratic and fluctuate not only daily, but also seasonally and annually. Changes in Lake Erie water levels are mirrored in the Old Woman Creek estuary.

AKZIDENZ GROTESK REGULAR



# **Old Woman Creek NERR Management Plan**

## **APPENDIX V**

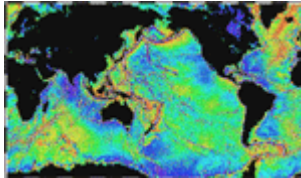
### **Lake Erie Literacy Principles**

# Lake Erie Literacy Principles and Concepts for Lake Erie Learning

Lake Erie literacy is an understanding of Lake Erie's influences on you and your influence on Lake Erie.

## Lake Erie Literacy Principles help a person:

- Understand the characteristics, functioning and value of Lake Erie;
- Communicate accurately about Lake Erie's influence on systems and people in and beyond its watershed; and
- Make informed and responsible decisions regarding Lake Erie and the resources of its watershed.



Principle	Ocean Literacy	Great Lakes Literacy	Lake Erie Literacy
1	The Earth has one big ocean with many features.	The Great Lakes, bodies of fresh water with many features, are connected to each other and to the world ocean.	Lake Erie, one of the five Great Lakes, is a body of fresh water with many features.
2	The ocean and life in the ocean shape the features of the Earth.	Natural forces formed the Great Lakes; the lakes continue to shape the features of their watershed.	Natural forces formed and continue to shape Lake Erie and its watershed.
3	The ocean is a major influence on weather and climate.	The Great Lakes influence local and regional weather and climate.	Lake Erie influences local and regional weather and climate.
4	The ocean makes Earth habitable.	Water makes Earth habitable; fresh water sustains life on land.	Water makes Earth habitable; fresh water sustains life on land.
5	The ocean supports a great diversity of life and ecosystems.	The Great Lakes support a broad diversity of life and ecosystems.	Lake Erie supports a broad diversity of life and ecosystems.
6	The ocean and humans are inextricably interconnected.	The Great Lakes and humans in their watersheds are inextricably interconnected.	Lake Erie and humans in its watersheds are inextricably interconnected.
7	The ocean is largely unexplored.	Much remains to be learned about the Great Lakes.	Much remains to be learned about Lake Erie.
8		The Great Lakes are socially, economically, and environmentally significant to the region, the nation and the planet.	Lake Erie is socially, economically and environmentally significant to the region and nation.

## **1. Lake Erie, one of the five Great Lakes, is a body of fresh water with many features.**

**a** Lake Erie is a prominent physical feature of North America and an internationally shared resource forming part of the political boundary between the United States and Canada.

**b** Lake Erie is the shallowest, warmest and most biologically productive of the Great Lakes. Lake Erie contains three basins, each with distinctive features, circulation and ecology, along with many harbors, bays and embayments.

**c** While smallest by volume, Lake Erie is an integral part of the Great Lakes, the world's largest supply of fresh surface water. Lake Erie's shore and watershed include the most southerly reaches of the Great Lakes ecosystem.

**d** Lake Erie is connected to the other Great Lakes which together form a watershed that drains to the Atlantic Ocean. The upper Great Lakes (Superior, Huron and Michigan) drain down the Detroit River into Lake Erie. Lake Erie flows over the Niagara Falls into Lake Ontario which flows through the St. Lawrence River into the Atlantic Ocean. Nutrients, dissolved gases, salts and minerals, sediments and pollutants from the upper Great Lakes and their watersheds are transported down rivers and through wetlands into Lake Erie.

**e** Lake Erie is an integral part of the Midwestern United States' and Canada's (or North American) water cycle and is connected to the region's watersheds and hydrologic cycle. Changes in the hydrologic cycle affect the quality, quantity and movement of water.

**f** Water currents circulate within Lake Erie and are powered by energy from the sun, wind, waves and differences in water density. The shape of the lakebed and its geographic orientation, the direction of the prevailing winds, the shore and the human-made structures along the shore influence the paths of circulation.

**g** Lake level is the height of Lake Erie relative to sea level as measured using the International Great Lakes Datum. Lake level changes are caused by basin-wide variations in precipitation, evaporation, runoff, snow melt, changes in the levels of the upper Great Lakes, wind and waves, as well as water withdrawals. Tides are not discernable in Lake Erie, a wind driven lake whose southwest to northeast orientation parallels the prevailing winds. This orientation combined with the shallowness of the lake makes Lake Erie especially prone to seiches or wind set-up.

**h** Lake Erie stratifies in the summer and in winter under ice cover, forming distinct layers based on water density differences due to temperature variations. Turnover occurs in the spring and fall when weather minimizes temperature differences and the layers mix. Turnover is the main way that oxygen-deficient and nutrient-poor water in the deeper areas of the lake can be mixed with oxygen-abundant and nutrient-rich surface water.

**i** Although Lake Erie is large, it is finite and its resources are limited.

## **2. Natural forces formed and continue to shape Lake Erie and its watershed**

**a** Many of the geological features underlying Lake Erie and its watershed originated when shallow tropical salt water seas covered the region. Large salt deposits below the lakebed are remnants of these seas. Many of the rocks now exposed on land were deposited or shaped during the advance and retreat of glaciers that carved the bed of Lake Erie.

**b** During the Ice Age, mile-thick sheets of ice covered what is now Lake Erie and northern Ohio multiple times depressing the crust with their weight. Since the glaciers retreated (more than 10,000 years ago), Earth's crust has been adjusting upward in a process of isostatic rebound that continues today.

**c** Lake level changes influence the physical features of Lake Erie's coast. Lake water levels vary over periods ranging from hours to millennia. Ancient beach ridges found in the watershed miles from the current water's edge mark previous lake shores. The difference between the yearly low and high water levels averages 1 to 2 feet.

**d** Erosion - the wearing away of rock, soil and other earth materials- occurs in coastal areas as wind, waves, river flow and currents in Lake Erie move sediments.

**e** Sediments are a product of erosion and consist of fragments of animals, plants, rocks and minerals. Sediments are classified by grain sizes, from silt and clay to sand, cobbles and boulders. Sediments are seasonally redistributed by waves and coastal currents, nourishing beaches and coastal wetlands.

**f** Beaches, barrier beaches and coastal wetlands protect upland areas by reducing the impact of storm waves and wind tides. Waves breaking on the beach area and wetland plants reduce wave height and energy.

### **3. Lake Erie influences local and regional weather and climate.**

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**a** Lake Erie affects weather and climate by impacting the region's energy and water cycles. Changes in Lake Erie's water circulation, water temperatures and ice cover can produce changes in local weather.

**b** Lake Erie warms by absorbing solar radiation. Lake temperatures are also affected locally by the temperature of inflowing rivers and the warm water discharge of power plants and other industries located along the shore. Lake Erie loses heat by evaporation and by warming the overlying air when the atmosphere is cool. After water vapor is released into the atmosphere, it condenses and forms precipitation, some of which falls within the Lake Erie basin.

**c** Lake Erie modifies the local weather and climate because water temperatures change more slowly than air temperatures. Lake water absorbs heat in summer and releases heat during cooler months. This results in cooler springs, warmer falls, delayed frosts and lake effect snow.

**d** Lake Erie has a significant influence on regional climate by absorbing, storing and moving heat and water. Lake effect precipitation can occur downwind when weather systems move over the lake and absorb moisture from Lake Erie.

**e** Lake Erie is influenced by global climate change affecting North America and the world. The climate in the Great Lakes region is changing with warmer temperatures and more variable precipitation patterns. The observed patterns of temperature increases and precipitation changes are predicted to continue. Winters are likely to become wetter and summers drier, increasing the frequency of floods and droughts.

### **4. Water makes Earth habitable; fresh water sustains life on land.**

**a** Fresh water has unique properties. Its density and electrical conductivity (a measure of salinity) are lower than that of salt water.

**b** Water is essential for life. All living processes occur in an aqueous environment.

**c** All aquatic and terrestrial organisms in Lake Erie's watershed need a source of freshwater to survive.



## 5. Lake Erie supports a broad diversity of life and ecosystems.

479

**a** Life in Lake Erie ranges in size from the smallest blue-green bacteria, such as *Microcystis*, to the largest animal that still lives in the lake, lake sturgeon.

**b** Lake Erie is the most biologically productive Great Lake. The most abundant life in Lake Erie are microorganisms. Phytoplankton are a type of microorganism that uses light to grow and reproduce. Phytoplankton are the primary producers in Lake Erie

**c** Lake Erie's watershed supports organisms from all taxonomic kingdoms.

**d** The Lake Erie ecosystem provides many examples of life cycles, adaptations and important relationships among organisms, such as parasitism, symbiosis, predator-prey dynamics and energy transfer.

**e** The Lake Erie ecosystem provides habitat for terrestrial and aquatic species. Lake Erie is multi-dimensional, offering vast living space and diverse habitats from the atmosphere to the shore, to the water surface and down through the water column into the lake bottom.

**f** Lake Erie habitats are defined by environmental factors. As a result of interactions involving abiotic factors such as temperature, clarity, depth, oxygen, pH, light, nutrients, pressure, substrate type and circulation, life in the lake is not evenly distributed temporally or spatially. Abiotic factors within Lake Erie can change hourly, daily, seasonally or annually because of natural variation and human influences.

**g** Abiotic conditions, prey availability and predation dynamics, influence the distribution and diversity of organisms from the surface to the bottom and from the nearshore to offshore.

**h** Coastal wetlands, such as marshes and fresh water estuaries, provide important and productive nursery areas for many aquatic and terrestrial species which rely on these habitats for protective structure, hunting grounds, migration stops, and raising offspring.

**i** Life cycles, behaviors, habitats and the abundance of organisms in Lake Erie and its watershed have been altered by intentional and unintentional introduction of non-native organisms. Non-native species may have positive or negative impacts on the Lake and its watershed.

**j** Some threatened species thrive in specialized areas of the Lake Erie ecosystem.

## **6. Lake Erie and humans in its watersheds are inextricably interconnected.**<sup>480</sup>

**a** Lake Erie affects many human lives. The lake supplies freshwater to more than 11 million people. It is a source of drinking water, transportation, and food as well as mineral and energy resources.

**b** One-third of the Great Lakes population lives in Lake Erie's 30,140 square-mile watershed. Lake Erie's watershed is the most urbanized, has the highest population density, and its land is the most intensively farmed of all the Great Lakes.

**c** Lake Erie is directly affected by the decisions and actions of people throughout its watershed which includes parts of Michigan, Ohio, Indiana, Pennsylvania, New York, the Canadian province of Ontario, and tribal lands. Lake Erie is also impacted by the decisions of people living in the watersheds of the upper Great Lakes (Superior, Huron and Michigan) because water from these lakes and their watersheds flows into Lake Erie.

**d** International treaties and agreements as well as local and national laws, regulations and resource management policies affect what is put into and taken out of Lake Erie. Coastal development and industrial or commercial activities throughout the watershed can lead to point and non-point source pollution. Humans have altered the biology of the lakes and the viability of species through harvesting, species introduction, habitat alteration, and nutrient and contaminant loading.

**e** Lake Erie, its coast and watershed are impacted by land use decisions, water use decisions and natural hazards. Physical modifications (changes to beaches, shores and rivers) can exacerbate effects of erosion, storm surges and lake-level changes.

**f** Eutrophication is a natural process by which freshwater lakes gradually become shallower, warmer and build up concentrations of plant nutrients as they age. Human activities in the watershed accelerate eutrophication which can lead to areas of oxygen depletion commonly referred to as "dead zones."

**g** Coastal wetlands protect communities and the lake itself by storing flood waters, absorbing wave energy to reduce coastal erosion, and removing sediment and other pollutants from watershed streams and rivers. Lake Erie coastal wetlands have been degraded and eliminated by human activities that have comprised the ability of wetlands to perform their natural functions.

**h** To ensure continued availability of Lake Erie assets, people must live in ways that sustain the lake. Individual and collective actions are needed to effectively conserve and manage lake resources for the benefit of all.

## **7. Much remains to be learned about Lake Erie.**

481

- a** Exploration and study of Lake Erie and its watershed are ongoing. Such exploration increases understanding of the role people play within the ecosystem.
  
- b** Understanding Lake Erie is more than a matter of curiosity. Exploration, inquiry and monitoring supports protection of Lake Erie ecosystems, resources and processes.
  
- c** Over time, the use of Lake Erie resources has changed significantly. The future sustainability of lake resources depends on our understanding of those resources and their potential and limitations.
  
- d** New technologies and methods of observation are expanding our ability to explore Lake Erie. Freshwater scientists rely on new technologies to monitor conditions in the lake and provide information to policy makers and leaders in coastal communities.
  
- e** Models help us understand the complexity of Lake Erie. Models can process and help visualize observations, describe interactions, expose information gaps and forecast future conditions.
  
- f** Exploring, understanding and communicating about the Lake Erie ecosystem are interdisciplinary efforts. They require close collaboration among professionals in science, technology, engineering and math, as well as public outreach and education.

## **8. Lake Erie is socially, economically and environmentally significant to the region and nation.** 482

**a** Lake Erie is a source of inspiration, recreation, rejuvenation, discovery and raw materials. It is also an important element in the heritage of many cultures and individuals.

**b** Lake Erie, its tributaries and coastal wetlands have been significant to historical settlement and development. The lake's name and the names of many cities, counties, tributaries and landmarks along its shore have Native American or immigrant origins. As a fresh water resource, Lake Erie continues to play a role in the habitation of the area.

**c** Lake Erie's moderating effects on climate influence the human culture, outdoor activities, agriculture and the health of adjacent coastal areas.

**d** Waterborne commerce moves millions of tons of cargo annually through Lake Erie. Shipping is an economically efficient method of transporting raw materials, finished goods and agricultural products. However, shipping also transports non-native species, several of which may be detrimental to the Lake Erie ecosystem.

**e** The economy is diverse around Lake Erie, with major sectors in industry, recreation and tourism, agriculture, commercial and sport fisheries, forestry and mining.

**f** Lake Erie has been and continues to be dramatically degraded and challenged by human endeavors. Individual and collective efforts are being made to restore the Lake and its resources. While restoration challenges still exist, Lake Erie is used as a representative model for environmental management and regional and international cooperation. Proper foresight and informed decision making will continue to make Lake Erie a model of environmental protection, restoration and innovation.

**Old Woman Creek NERR  
Management Plan**

**APPENDIX W**

**Memorandum of Understanding, ODNR – Wildlife,  
on behalf of the Old Woman Creek National  
Estuarine Research Reserve  
and  
Erie Soil and Water Conservation District**

**Memorandum of Understanding**  
**between the Ohio Department of Natural Resources-Division of Wildlife,**  
**on behalf of the Old Woman Creek National Estuarine Research Reserve,**  
**and**  
**Erie Soil and Water Conservation District**

## **Purpose**

Recognizing the need for effective collaboration in carrying out priority responsibilities relating to the stewardship of the Old Woman Creek National Estuarine Research Reserve (NERR) and coastal watersheds in the lower Great Lakes, specifically within the Firelands Region of north-central Ohio, the Ohio Department of Natural Resources (ODNR), Division of Wildlife, hereafter referred to as the "Division," and the Erie Soil and Water Conservation District, hereafter referred to as the "District," accept this Memorandum of Understanding (MOU) as the document that describes the process for collaboration and mutually led program implementation..

Cooperation between these two entities facilitates a core function of the Old Woman Creek NERR to promote stewardship of the estuary and similar coastal wetlands and watersheds, as described in the Old Woman Creek NERR management plan, and strategic goals of the National Estuarine Research Reserve System. The partnership will also implement restoration and protection projects in the Old Woman Creek watershed and broaden the capacity of the Reserve to provide stewardship education throughout the Firelands region. The District and Division believe that this partnership will continue to flourish with a clear understanding of goals, roles, and responsibilities.

The activities performed will be in accordance with a NOAA-approved Old Woman Creek NERR management plan and federal law, including the federal Coastal Zone Management Act of 1972 and NOAA's implementing regulations at 15 C.F.R. 921, the Old Woman Creek watershed action plan, as approved by the Ohio EPA and ODNR, Division of Soil and Water Conservation, and annual work plans mutually developed by the District and Division.

## **Authorities**

The Ohio Revised Code (ORC), Chapter 1515, describes the District's authorities and responsibilities as a subdivision of the State of Ohio. The ORC 1531.04 describes the Divisions's power and duty to plan, develop, and institute programs based on the best available information. Specific resource protection statutes for the entirety of the Old Woman Creek State Nature Preserve, which is the protected site that comprises the Old Woman Creek NERR, is found in ORC Chapter 1517.

The federal Coastal Zone Management Act of 1972 (CZMA), as amended, 15 C.F.R. Part 921.1(a), established the National Estuarine Research Reserve system, to provide opportunities for long-term research, education, and interpretation.

## **Basis for Collaboration**

The Division staffs and manages the Old Woman Creek NERR in Erie County. This program, which operates in the Old Woman Creek State Nature Preserve, is a state-federal partnership to promote stewardship of estuaries through research and education. The Division strategic plan for 2001-2010 initiated a strategic program area relating to streams and watersheds because of the ecosystem value of Ohio's waterways to fish and wildlife species.

The District is committed to the protection, preservation and restoration of natural resources by providing education, funding opportunities and technical assistance to all Erie County land users. As a mechanism to accomplish this mission, the District has developed a regional watershed management and resource stewardship program with a particular interest in small Lake Erie tributaries like the Old Woman Creek watershed in the Firelands region of northern Ohio.

## **Project Tasks**

- The District will work with the Division, through an executive committee, to operate a watershed stewardship program within Old Woman Creek (041000-120-304) and the Firelands Coastal Tributaries (FCT) service area. Additional watersheds within the FCT service area include the 12-digit Hydrologic Unit Code watersheds: Cold Creek (04100011-130-050), Mills Creek (041000-110-103), Pipe Creek (041000-110-102), Sawmill Creek (041000-110-101), Chappel Creek (041000-120-302), and all drainages to Sandusky Bay and Lake Erie found within the District's jurisdictional boundary (Exhibit B). As the employer of the watershed coordinator, the District will provide daily supervision, over-head, administrative and technical support. Fiscal reporting for the project will be done in collaboration with the Division, in keeping with NOAA grants management schedules and fiscal policies.

The District's watershed coordinator will provide assistance to Old Woman Creek NERR and other Division staff implementing core responsibilities associated with the stewardship program. This will require operation at multiple scales:

- Within the NERR boundary, the watershed coordinator will serve as a resource to the Division in the development and implementation of resource stewardship projects, including management-oriented research and monitoring (.15 FTE)
- Outside the NERR boundary, the watershed will work to implement the resource protection and restoration elements of the Old Woman Creek watershed action plan, including its watershed research and monitoring elements (.4 FTE)
- Within the District's jurisdictional boundary and the FCT service area, the watershed coordinator will provide technical assistance and training and transfer coastal research information related to resource protection and restoration (.25 FTE)
- The watershed coordinator will provide watershed program administration, participate in District-related functions as required by employment, continue professional development, and represent the NERR as needed for stewardship function updates at NERR meetings (.20 FTE)
- The watershed coordinator will document level of effort using the Soil and Water Information Management System (SWIMS) utilized by the ODNR, Division of Soil and Water Resources.

Specific responsibilities of the District and Division are contained within the Roles section of this MOU.

## **Grant Administration**

Grant funds will be paid direct from NOAA to the District to be used for salary, benefits and ancillary costs associated with the watershed coordinator position. The District will disburse the funds for eligible project costs as outlined within this MOU, submitted National Oceanic and Atmospheric Administration (NOAA) Grant Agreement, and any NOAA-authorized addendums hereto.

The District will provide information to the Division for review and acceptance and make available for review copies of all grant progress reports as requested. The Division will provide grant application and reporting assistance as needed by the District to meet all NOAA granting policies and regulations.

## **District's Roles\***

The District will work with the Division to provide the agreed upon services listed in this MOU.

1. The District will provide the receipt, expenditure, and fiscal accounting of funds received through the Grant Agreement. Local match funds, provided by the Division or direct from project partners, will also be properly accounted and reported for grant purposes.
2. The District will coordinate with the Division, Executive Committee, and project partners to develop an annual work plan to accomplish project deliverables in a timely manner; the annual work plan must be approved by the Division and subsequently used to develop the Grant Agreement with NOAA.
3. The District, in coordination with the Division, will provide semi-annual technical, quarterly fiscal and final reports as required by the Grant Agreement to describe all activities undertaken, and provide copies of all fliers, notices, and any data collected for reporting to state and local agencies and project partners.
4. The District will actively participate in identification and recruitment of additional project partners.
5. The District will provide technical services as required to achieve the deliverables of the grant.

## **Division's Roles\***

1. The Division will coordinate with the District, Executive Committee, and project partners to provide input for the annual plan of work for the watershed coordinator position and will review, comment on and approve a final work plan annually prior to the District submitting Grant Agreement documents.
2. The Division will coordinate with NOAA annually on issues related to funding for the NERR and will advise NOAA and the District regarding the amount of funding available to support the District's approved annual work plan at the time of submittal of Grant Agreement documents.
3. The Division will provide project information in a timely manner through channels identified in the annual work plan.
4. The Division will provide assistance to the watershed project through related activities such as improvement days, education events, and other public involvement activities.
5. The Division will assist with contacts and the provision of contact names, addresses and phone numbers of local leaders, including civic leaders, civic groups, senior organizations, fraternal groups, scout leaders, school liaisons, business leaders and any other interested parties that should be contacted through an outreach program.

\*See Exhibit A, Roles and Responsibilities Specified

## **Agreed Procedures**

- That the working relationship will be defined to include lines of communications with appropriate representatives. The District and the Division will meet at least once a year, outside the Executive Committee, to network and exchange information.
- That the Division and the District will meet when necessary to review and coordinate activities and programs with the aim of developing a multi-disciplinary approach to resource management.
- That all parties will review quality of service and address concerns as they arise.



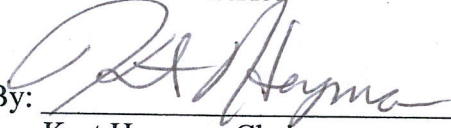
- That credit will be given jointly to the District, the Division, and project partners in project publications. Acknowledgement of NOAA will be in accordance with special award conditions.
- All services of the District are offered on a non-discriminatory basis without regard to race, age, marital status, handicap or political persuasion.
- The Division recognizes the District's obligation to make its reports and other written materials available to the public on request in accordance with the Ohio Public Records Act.
- The District shall prepare and provide required report information to the designated representative(s) of the Division with reasonable time for review and approval prior to submission deadlines required by the Grant Agreement.
- Upon demonstration of concurrence through signature of designated representatives of the District and Division, the required reports and documentation shall be submitted as required by the Grant Agreement.

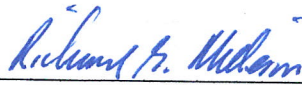
This working agreement may be amended or terminated at any time by mutual consent of both parties, and the agreement may be terminated by either party giving sixty (60) days notice in writing to the other.

In witness thereof, the Memorandum executed and agreed to on the day, month and year written:

**Erie Soil and Water  
Conservation District**

**Ohio Department of Natural Resources**

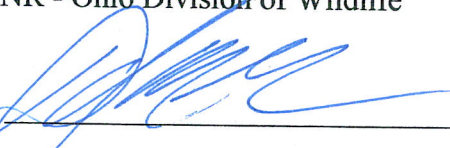
By:   
Kurt Heyman, Chair

By:  B.D. (For)

Date: 2/19/2010

Date: 3/2/10.

ODNR - Ohio Division of Wildlife

By: 

Date: 2-25-10

## **Exhibit A**

### **Roles and Responsibilities, Specified**

#### **The District Shall:**

1. Provide a staff position to coordinate science-based watershed stewardship activities outside the NERR and serve as resource for restoration and stewardship activities within the NERR boundary using all applicable and relevant coastal research.
2. Ensure continuity should the staff position becomes vacant. The District shall notify the Division and post the position following a vacancy and shall complete the hiring process in a timely manner.
3. The staff position will be hired in accordance with applicable requirements.
4. Ensure the watershed coordinator position's time is used solely for the duties outlined in this MOU and the Division-approved annual work plan to address watershed-related activities.
5. Provide a watershed program oversight role for the Division through inclusion of a Division staff person on the watershed program's executive committee.
6. Annually submit applications, and accept federal financial assistance awards to support operations of the Old Woman Creek NERR under section 315 of the CZMA.
7. Disburse Section 315 CZMA federal funds received for support of Old Woman Creek NERR in accordance with a budget and work plan approved by the Division.
8. Comply with all terms and conditions of NOAA financial assistance awards pertaining to Section 315 of the CZMA for operations of the Old Woman Creek NERR.
9. Submit required financial reports to NOAA for each federal financial assistance operations awards under Section 315 of the CZMA.
10. Submit required performance progress reports to NOAA for each federal financial assistance operations award generated in collaboration with the Old Woman Creek NERR under Section 315 of the CZMA.
11. Provide matching funds for CZMA Section 315 federal assistance awards needed to complete tasks undertaken pursuant to this paragraph if the federal funds are not matched by the Division.
12. Assist the NERR with the development for science-based stewardship strategies and priorities for watershed management-oriented research for inclusion within the Old Woman Creek NERR Management Plan.
13. Coordinate a Volunteer Monitoring Program to develop citizen scientists within the Old Woman Creek watershed and in other watersheds in the FCT service area.
14. Provide training to the volunteer monitors.
15. Assist with development and provision of science-based training for decision-makers and technical assistance for local governments in collaboration with the Ohio Coastal Training Program.
16. Provide stewardship education opportunities as an enhancement of the NERR's programming activities both within and outside the NERR boundary.
17. When requested, serve as Stewardship Coordinator, representing the OWC NERR program at national NERR meetings.
18. When requested, serve as a resource to the Old Woman Creek NERR Advisory Council
19. Represent the watershed program in regional watershed groups and conferences as requested.
20. Provide staff to assist the watershed coordinator in stewardship tasks in the District's jurisdictional boundary and the FCT service area.

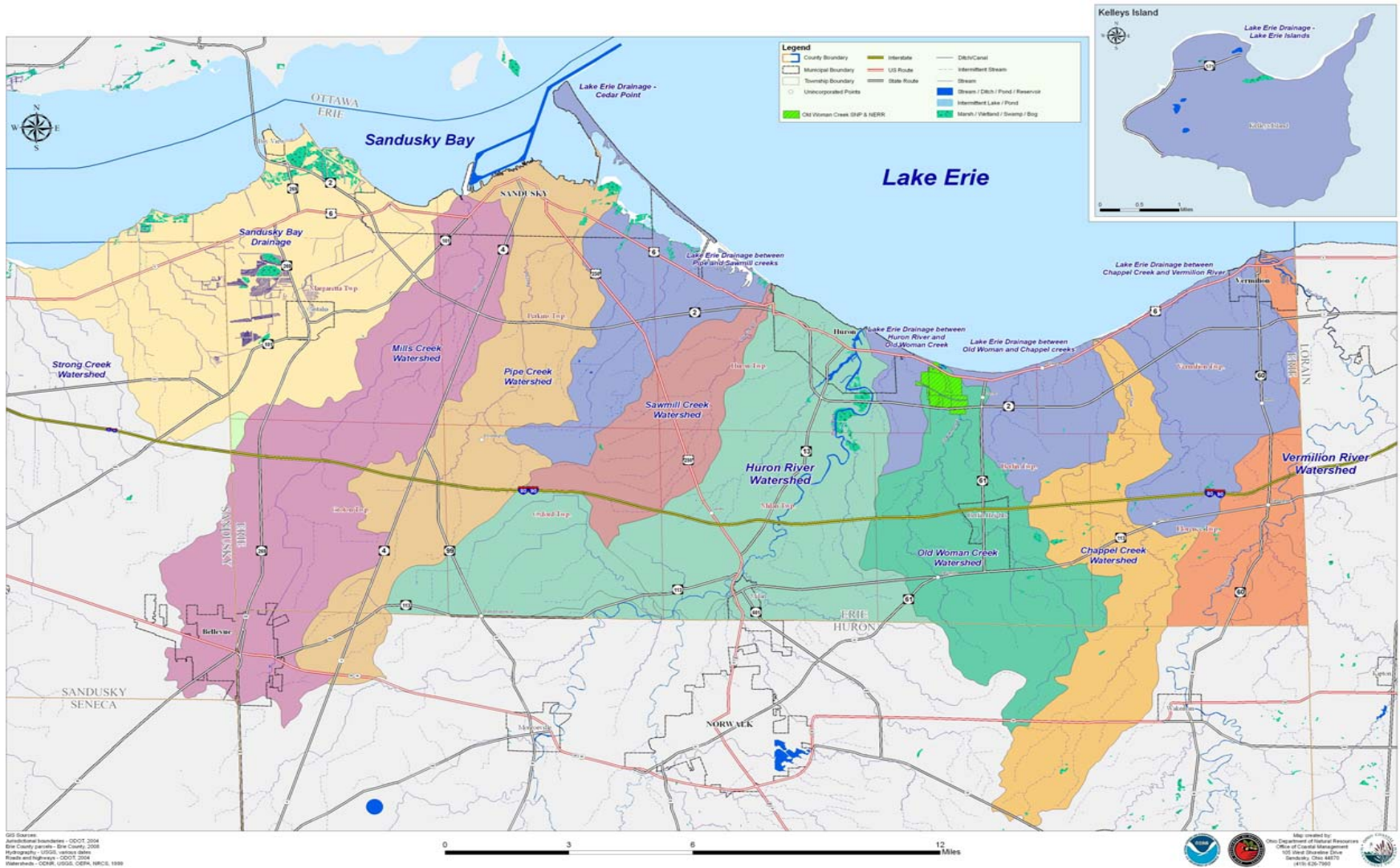
21. Provide office space, equipment and supplies to facilitate activities of the watershed coordinator position, as needed.
22. Implement strategies identified in the Old Woman Creek Watershed Action Plan (OWC WAP).
23. Provide technical assistance to develop additional Watershed Action Plans within the FCT service area as requested by interested communities.
24. Pursue additional funding sources to implement the OWC WAP.
25. Develop budget and annual work plan.
26. Manage active grants, compile progress reports, and respond to information requests.
27. Maintain separate and proper accounting of all federal, state, local, and in-kind expenditures and contributions.
28. Maintain a watershed website and contribute information to Reserve website.
29. Design, edit and distribute a quarterly newsletter to local watershed residents identified in the NERR landowner database, and additional residents and program partners compiled by the watershed coordinator.
30. Sustain current partnerships through workgroup committees and a semi-annual partnership meeting.
31. Develop and uphold workgroup committees to engage program partners and implement strategies identified in the OWC WAP.
32. Develop an annual report for the program to be submitted to program partners.
33. Assist with watershed-related equipment purchases and facility usage fees.
34. Provide technical assistance to urban and rural land-users.
35. Provide technical assistance to communities within the District's jurisdictional boundary and FCT service area in regard to stormwater practices in accordance with local, state and federal regulations.
36. Serve on the Erie County Regional Planning, Technical Advisory Committee to provide review of development proposals with regard to environmental characteristics of the site and best management practice options for the development site.
37. Assist with professional development opportunities for the watershed coordinator.
38. Make contacts to landowners regarding land conservation options.

**The Division Shall:**

1. Provide technical support for implementing the OWC WAP which includes but is not restricted to GIS mapping and analysis, monitoring and research, education, and program administration.
2. Address watershed management-related research questions and assess the research needs of watershed managers.
3. Invite the participation of the watershed coordinator as part of multidisciplinary NERR teams to design and implement watershed management-oriented research, education programs, and exhibits.
4. Develop monitoring protocols to gauge implementation of watershed stewardship practices.
5. Collaborate with the watershed program to market watershed program education and volunteer service opportunities.
6. Make contacts to landowners regarding land conservation options.

7. Provide assistance with grant research, development, and advise on their management as requested.
8. Assist the District in promptly meeting NOAA information requests relating to national stewardship initiatives.
9. Review the development of the watershed program budget and annual work plan and approve the same when they substantially meet Division and NOAA goals and objectives.
10. Serve on the executive committee for the watershed program
11. Serve in workgroup committees to support implementation of OWC WAP.
12. Provide technical assistance in utilizing NERR research/inventory information to manage watersheds.
13. Provide facility space as available.
14. Permit usage of NERR equipment for watershed program purposes.
15. Provide materials for collaborative stewardship projects within the NERR boundary.
16. Provide lab sample analysis, data collection and data management.
17. Assist with monitoring protocol for specific project evaluation as well as overall program effectiveness.
18. Assist with watershed mailings.
19. Assist with volunteer monitoring training.
20. Assist in the development of human dimension research that would inform watershed management.
21. Represent the FCT at regional watershed groups and conferences as requested.

# Exhibit B FCT Service Area



**Old Woman Creek NERR  
Management Plan**

**APPENDIX X**

**Report on Public Comment Period, March – April  
2011**

## **Public Comment Period Report**

A complete draft of the OWC NERR Management Plan was uploaded to the Reserve website and was placed on Federal Register Notice on March 24, 2011.

The 30-day comment period ended on April 23, 2011. No written comments were received during that time frame.

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