

Delaware
City
Eco-Tourism
Project

Draft
**Ecological
Assessment and
Restoration
Concept Report**

A component of the Main Street
Delaware City Eco-tourism Program



Discover
Learn
Explore



Biohabitats
Incorporated

Project Support — Sponsors And Partners

In order to make the vision of Delaware City as an eco-tourism destination a reality, Main Street Delaware City needed to find financial support and sponsors to start the process. Initial support has come in the form of a Community Environmental Project Fund grant provided by Delaware Department of Natural Resources (DNREC) Community Involvement Advisory Council (CIAC). Main Street Delaware City, Inc. applied for and was successful in receiving the CIAC grant award to support the initial work on the Delaware City Eco-tourism project.

The grant program requires a DNREC Division sponsor for awarded projects and the one designated for this project is DNREC Division of Parks & Recreation. In addition to Main Street Delaware City, Inc. as the project lead and The City of Delaware City as a key partner, there are a number of other public, private and non-profit cooperators and partners involved in this project.

Project Sponsor & Lead

DNREC Division of Parks & Recreation
Main Street Delaware City, Inc.

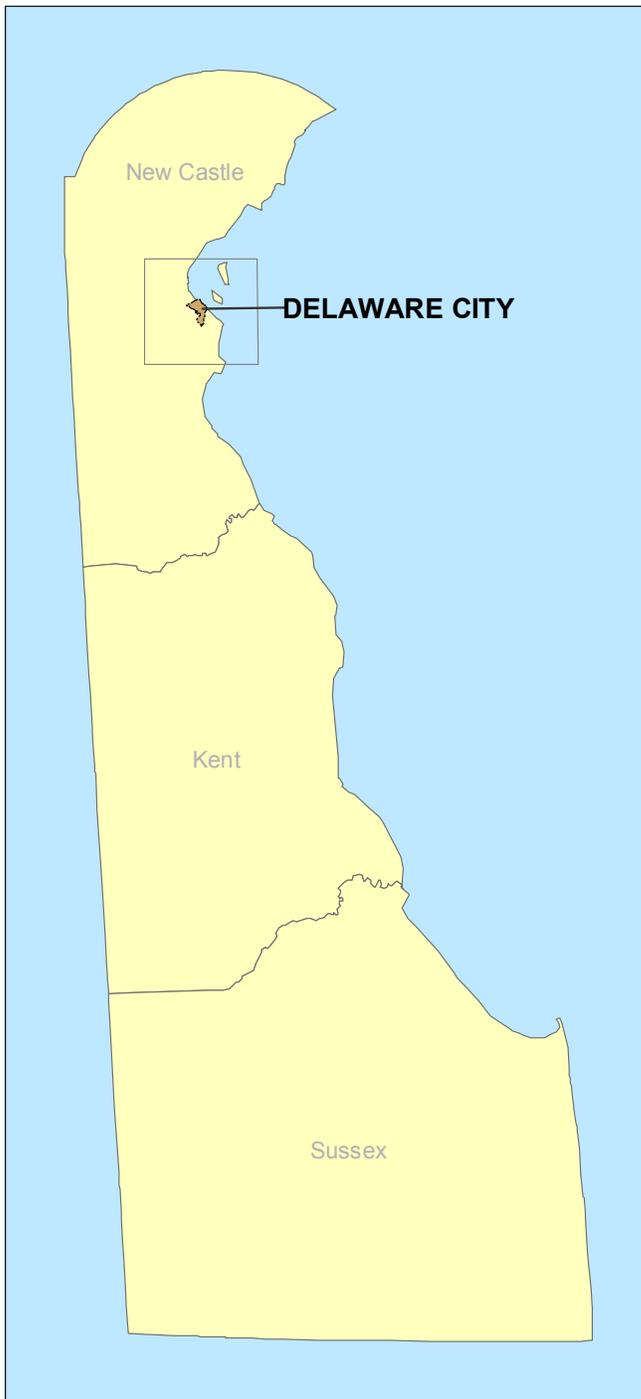
Cooperators & Partners

Delaware Audubon Society
Delaware Greenways
Delaware Nature Society
DNREC Division of Fish & Wildlife
DNREC Division of Soil & Water Conservation
New Castle County Government
New Castle County
Economic Development Council
State of Delaware
Economic Development Office
The City of Delaware City
Valero Delaware City Refinery
Wilmington Trail Club

Project Consultants

A. Kreiner Company
Biohabitats, Incorporated

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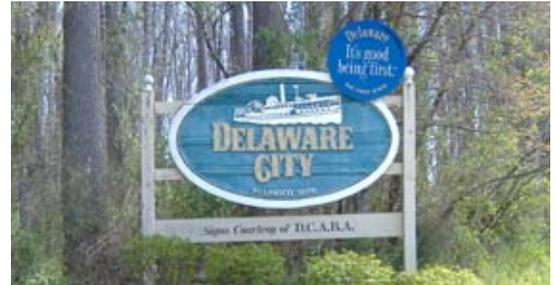
1. Introduction

DELAWARE CITY—A HIDDEN GEM

Nestled along the banks of the Delaware River in New Castle County, Delaware there lies a hidden treasure. Motoring past in a boat in the middle of the River or driving down Delaware State Highway 1, you may never know it's there. But, if you venture east on Route 9 or sail along the shoreline of the River at the eastern entrance of the Chesapeake & Delaware Canal you will find a vibrant community with shops, wood frame homes, and restaurants. You will soon find the town has inviting character, charm and hospitality. Natural wonders are abundant in and around the town. In order to truly discover the amenities and appeal of this town, further exploration is in order.

THE SETTING—UNIQUE ECOLOGY

At first impression you may feel the predominance of the local industrial complex, an oil refinery on the north and west perimeter of Delaware City. Upon further exploration you will discover an area rich in recreational and cultural amenities including State parks & wildlife areas, historical sites, Federal canal lands and local community parks. Perhaps even more surprising is that the Delaware City area has extensive natural areas with significant ecological resources, including many that are publicly owned and accessible. These areas contain expansive freshwater marshes and ponds, forested wetlands, stream channels, coastal woodland communities and shoreline tidal marshes. They are rich in native fish and wildlife, diverse plant assemblages, interesting geological resources, and locations with spectacular views.





Eco-tourism is:

“Ecologically sustainable tourism with a primary focus on experiencing natural areas that fosters environmental and cultural understanding, appreciation and conservation”

— The Green Globe 21 International Ecotourism Standard

“Responsible travel to natural areas that conserves the environment and improves the well-being of local people”

—The International Ecotourism Society (TIES)

ECO-TOURISM— AN OPPORTUNITY

The rich, diverse and extensive natural resources provide a significant opportunity to make the Delaware City area an eco-tourism destination. Main Street Delaware City, Inc. is a local non-profit organization that has worked for more than a decade on a mission to improve and market historic and cultural attractions that bring new residents, visitors and businesses to the town. This group developed a focused strategic approach to economically revitalize the town. A key component of that strategy is to develop an Eco-tourism Program for Delaware City to enhance, make accessible, interpret and market ecologically based tourism opportunities in order to attract visitors to this inviting riverfront town. A critical first step for this project is completion of an ecological assessment and the identification of ecological restoration opportunities.

LEARN MORE

This report provides the first important piece to start the project on a solid ecologically-based foundation. The remainder of this report covers the ecological conditions assessment component of the project including characterization of ecological resource sites, identification of significant ecological features and identification of potential ecological restoration opportunities.



2. Ecological Resources

EXISTING INFORMATION—DOCUMENT REVIEW

Existing Information Collection & Review

Biohabitats collected and reviewed existing documents from various partners, collaborators and other organizations including several divisions of Delaware DNREC, Delaware Office of State Planning, US Army Corps of Engineers, US Fish and Wildlife Service, New Castle County and Delaware Audubon Society. The documents obtained and reviewed include:

- Aerial photographs
- Geographic Information System—geospatial maps
- Ecological investigation reports and data
- Natural resource management plans
- State park, wildlife area and historic facilities websites



Previous Reports and Plan

Biohabitats obtained and reviewed several management plans, investigation reports and data documents from by the project partners and collaborators. These documents include the following (Please see Bibliography for full citations):

- Pea Patch Island Heronry Region: Special Area Management Plan
- Pea Patch Island Heronry Region: Special Area Management Plan, Progress Report
- Environmental Enhancement Projects for Delaware's Coastal Zone
- New Plans for Old Dragon Run
- Harbingers on the Wing—Special Place, Special Plan
- The Thousand Acre Marsh Wetland Rehabilitation Project: An Innovative Approach to Management of Private Lands
- Delaware National Estuarine Research Reserve Management Plan
- Transformation of the Lands of the Chesapeake & Delaware Canal, Maryland and Delaware
- Grass Dale Restoration New Castle County Delaware, Section 1135 Final Ecosystem Restoration Report and Environmental Assessment

The reports and other documents reviewed helped to identify potential investigation sites, ecological conditions, and current and past resource management activities.





Pea Patch Island Heronry Management Plans

The most significant documents obtained from an ecological resource context standpoint are The Pea Patch Island Heronry Region Special Area Management Plan (SAMP Core Group 1998) and The Pea Patch Island Heronry Region Special Area Management Plan—Progress Report (SAMP Core Group 2001). The Special Area Management Plan addresses not only the ecological resources of Pea Patch Island and its heronry, but also takes a comprehensive look at the ecological conditions and man-

agement implications for a 15-kilometer area surrounding the heronry. After 21 of the 27 management strategies recommended in the SAMP were implemented, the SAMP Core Group was disbanded. However, the responsible resource agencies continue to conduct several of the recommended natural resource management measures for Pea Patch Island and surrounding areas. The need to actively manage regional ecological resources is critical to the future of the heronry.

Geographic Information System (GIS) Mapping

The GIS maps and aerial photographs were used to create site maps for field work, analysis mapping and identifying ecological restoration opportunities. The GIS layers obtained from public available mapping files include the following:

Information Content	File Name	Source And Web Link
Forest Cover	Forests	New Castle County GIS
FEMA Flood Coverage (Floodplains)	FEMA_Flood	New Castle County GIS
Drainage Coverage	drainage	New Castle County GIS
Critical Natural Areas	critical	New Castle County GIS
Coastal Zones	coastal	New Castle County GIS
Parks and Public Areas	parks	New Castle County GIS
Planning Districts	planning	New Castle County GIS
Major Highways	highway	New Castle County GIS
Elevation Contours	elevationcontours	New Castle County GIS
County Coverage	county	New Castle County GIS
Development Areas	development	New Castle County GIS
National Wetland Areas	Nat_Wetlands	New Castle County GIS
State Wetland Areas	State_Wetlands	New Castle County GIS
Surface Water Coverage	Surface_Water	New Castle County GIS
Water Resources Coverage	Water_Res	New Castle County GIS
Secondary Roads	streets	New Castle County GIS
City of DE Boundary	municipalities	New Castle County GIS
Watershed Coverage	wshed	New Castle County GIS
Vacant Residential Lots	Vac_Res_Lot	New Castle County GIS
2002 Land Use Land Cover	2002_delaware_lulc	DE State Planning Dept.
Wetlands Coverage	CONUS_Wetland_polgons	http://wetlandsfws.er.usgs.gov/wtln ds
State Color Orthophoto	Ortho_e1-1_s_de003.sid	USDA-FSA-APF
State B/W Orthophoto	m3907510-m3907545	USDA/FSA
Tax parcels	tp	New Castle County GIS
Subdivisions	subdivisions	New Castle County GIS
Historic Area Polygons	historic_poly	http://www.state.de.us/shpo/information/GISdata.shtml
New Castle Co Tax Parcels	0506nctax_parcel s	http://nccde.org/landuse/home/webpage1.asp



Ecological Resources (cont.)

SITE INVESTIGATION

Study Area Parcel Ownership

The project study area extends from Delaware State Route 13 to the Delaware River (including Pea Patch Island), south to the C&D Canal and north nearly to Red Lion Creek (See Figure 1.1) The project area includes property parcels with many different owners.

Preliminary review of the New Castle County tax parcel maps revealed more than 50 large parcels in the project area that are under public, private and non-profit ownership. This does not include hundreds of other small residential and commercial properties within Delaware City that are under an acre in size that were not evaluated for this project.

In order to determine parcel ownership and potential access to sites, we first cross-referenced the tax

parcel number on the GIS maps with the New Castle County parcel view ownership database. This internet accessible database provides information regarding property address, subdivision, owner name & address, and lot size among other attributes. The ownership records were obtained for all the large lot parcels to support the initial site reconnaissance.

Initial Site Reconnaissance

Initial site reconnaissance was conducted based on the tax parcel database records. Sites in public ownership were freely accessed and private parcels were preliminarily viewed from public property. The initial reconnaissance was used to make a determination as to whether a parcel was a candidate for further investigation of potential ecologically significant resources and ecological restoration opportunities. If a site was determined to be almost entirely developed





Figure 1.1 Study Area Assessment Parcels

residential, commercial or municipal use it was eliminated from future ecological site assessment. Parcels that were determined to contain natural areas including woods, wetland, streams, ponds and fields were targeted as investigation parcels for further assessment. Privately owned parcels containing natural areas were identified for owner access authorization request.

Several relatively small publicly owned parks and community facilities not containing significant natural areas were identified as potential support parcels. The idea for identifying support parcels is based on the potential for existing public infrastructure to provide opportunities for vehicle parking, way-finding points, information kiosks and access points to nearby natural areas.

Site Investigation—Observations

For the accessible investigation parcels,

the following field observations were recorded for each site:

- Site Identification and Ownership
- Existing Management Activities
- Vegetation and wildlife habitats
- Ecological disturbances/Impacts
- Ecological Restoration Opportunities
- Possible Eco-tourism Recreation Opportunities

Collaboration

In addition to the mapping and reports provided by the collaborating partners, discussions with their natural resources personnel (Biologists, land managers and public relations officials) provided additional background information on their sites. One very valuable example of this cooperation was afforded by DNREC Division of Parks and Recreation. One of their biologists, Kendl Sommers, provided a site tour of several of the lands they

manage and identified significant ecological resources and restoration needs. Ms. Sommers provided information for Pea Patch Island/Fort Delaware State Park, Fort DuPont State Park and Grass Dale Center.

For a variety of legal, security and site control issues, access was not allowed by Valero to the natural areas within their extensive Delaware City Refinery land holdings. However, Mary Jen Beach, Public Affairs Manager, provided a copy of the Conservation Easement and Land Restoration Project agreement between the former refinery owner Motiva, The Premcor Refining Group and the State of Delaware DNREC. This document identifies 285 acres of agricultural lands currently leased for farming, that are to be converted to a natural state involving tree planting, invasive species control and maintenance and deer management.



Ecological Resources (cont.)

ECOLOGICAL ASSESSMENT

Project Setting

Delaware City sits at the juncture of extensive natural lands and developed areas. Delaware City is also located at the eastern end of the Chesapeake and Delaware Canal (C&D) an artificially created navigation channel connecting the ports of Baltimore, Wilmington and Philadelphia. The Canal primarily provides a more direct route to the Atlantic Ocean from the Port of Baltimore than is available exiting Chesapeake Bay to the south. In addition to being a commercial shipping channel, the C&D Canal is a heavily used recreational boating area. The Canal and undeveloped lands along it also provide a physical and biological corridor between Chesapeake Bay and Delaware Bay systems. Delaware City has shoreline along the C&D Canal, Branch Canal and the Delaware River.



Ecological Importance

The Delaware River shoreline and Delaware Bay are part of an important migratory bird route along the Atlantic coast. Millions of waterfowl, wading birds and shore birds migrate along the Atlantic Flyway during spring and fall migrations using the Delaware Bay estuary system for critical migratory stop-over and wintering areas. Further south of Delaware City, along the Delaware Bay shoreline, there are important horseshoe crab reproduction areas along with migratory shorebird foraging and resting areas that are globally unique. The southern shoreline of Delaware Bay attracts biological researchers and bird-watching visitors from all over the world. Lands in the Delaware City area have been designated by the Audubon Society and the American Bird Conservancy as Important Bird Areas (IBA) as follows:



- Delaware Coastal Zone (Including Delaware City) a 'Globally Important' IBA
- Pea Patch Island (Fort Delaware State Park) a 'Continentially Important' IBA

Important Bird Areas (IBAs) are sites that provide essential habitat for one or more species of bird. IBAs may be a few acres or thousands of acres, but usually they are discrete sites that stand out from the landscape. IBAs often support a significant proportion of one or more species' total population.

– Delaware Audubon Society





Figure 2.1 Aerial View of Delaware City. Yellow boundary represents city limits.

As an area of continental importance for birds Pea Patch Island contains a heronry and a breeding colony of nesting wading birds including herons, egrets and ibises. Pea Patch Island contains the largest such heronry on the east coast north of Florida. Along most of the east coast these vital heronries have been declining for several decades.

The waterways of the Delaware River estuary provide spawning areas for anadromous fish that migrate from the ocean, up the Bay to the Delaware River and its tributary streams in order to reproduce. A large diversity of estuarine and marine fish species are also supported in the brackish portions of the river and bay by providing various requirements for habitat/cover, forage, breeding and juvenile nursery areas.

Significant Ecological Sites

Field observations were used along with the GIS mapping and previous studies to identify a list of significant ecological sites, including:

- Natural stream channels, floodplains and riparian corridors
- Native coastal plain woods, scrub-shrub, meadows and corridors
- Extensive and/or unique forested wetlands and non-tidal marshes
- Natural shoreline areas and tidal marshes
- High avian use and important habitat areas
- Unique geologic formations and fossil deposits
- Unique or diverse wildlife and plant species occurrences



Ecological Resources (cont.)

Based on the document review, personal communication and site observations the following significant ecological sites were identified in the project area;

1. Pea Patch Island—Heronry/Mixed Wading Bird Colony

Pea Patch Island is a 310-acre island located in the Delaware River estuary near Delaware City (SAMP 1998). There are nine different species of wading birds, including herons, egrets, and ibises known to have nested in breeding colonies on the island.



In a 2003 study of the heronry 3285 heron nests were surveyed (DNREC 2006). This heronry is the second largest on the east coast north of Florida, and is continentally important due to this unique occurrence. There are tidal creeks within extensive

tidal marsh areas on the island. There are also large areas of coastal plain woodlands including stands of tall trees and shrub-dominated patches.



Courtesy Delaware Audubon

2. Dragon Run Natural Area—Creek and Marsh

Dragon Run marsh is the largest freshwater marsh system in the northern part of Delaware. Diverse freshwater wetland plants occur here including arrow head, marsh mallow, water lily, duckweed, cattails and arrow arum. Extensive wildlife use includes muskrats, turtles, waterfowl and other migratory birds. In addition to the marsh, the Dragon Run ecosystem includes open stream channel and forested wetlands, part of extensive riparian corridor including adjacent upland forests. There are indications of the occurrence of rare plant species,



but the Delaware Natural Heritage Program has not provided information on the species and their occurrences as of the writing of this draft report.



Courtesy Delaware Audubon

3. Grass Dale Center—Meadows and Wetlands

The Grass Dale area is a unique natural area that is a part of Fort DuPont State Park. Six major habitat types are found within a 100-yard radius including woods, tidal marsh, fresh water pond, hedgerows, meadow and scrub (DE Audubon 2002). These habitats are attractive to a diversity of wildlife.



The catalog of flora and fauna now stands at 134 bird, 84 plant, 47 insect, 16 mammal, 9 amphibian, 1 minnow and 1 crustacean species (DE Audubon 2002). The meadow areas of Grass Dale provide habitat potential for many birds

including grassland species. Grass Dale wetland areas include extensive tidal marsh areas and a freshwater pond.



4. Delaware City Lands at Branch Canal—Tidal Wetlands

This area is an undeveloped city owned parcel that contains extensive tidal marsh area, scrub edge habitat and some coastal woodland fringe. This area is predominantly a complex of tidal marsh and open water and has been observed to be used as foraging areas for long-legged wading birds including great egrets.



This site is a valuable open space area and natural system connection from the developed areas along 5th Street to the Branch Canal.



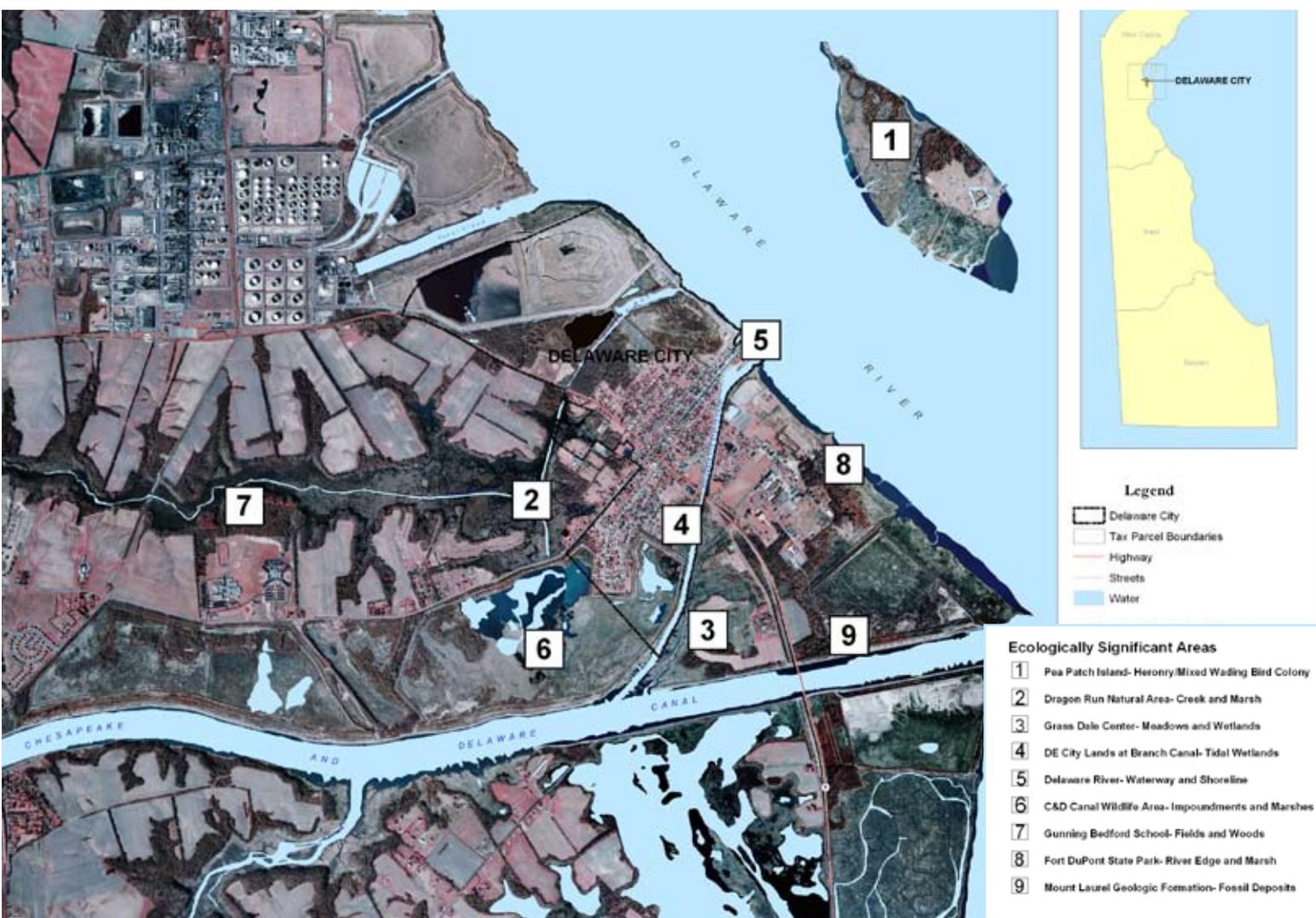


Figure 2.2 Ecologically Significant Areas in Delaware City. The numbers correspond to those on pages 10 -12.

5. Delaware River—Waterway and Shoreline

This section of waterway and shoreline occurs from Fort DuPont northward to the Valero refinery area. The River is a major fish migration and habitat area. The River corridor is also used as a bird migration route, foraging areas for birds that consume fish and it also provides resting and roosting area for waterfowl and other water birds. The shoreline area includes tidal



fringe marshes that provide erosion protection, water quality enhancement and habitat for wildlife foraging and cover.

6. C&D Canal Wildlife Area—Impoundments and Marshes

The impoundments are managed by DNREC as habitat for large numbers of waterfowl including ducks and geese, and they provide resting and roosting areas as well as foraging habitat. The impoundments are used as part of a managed hunting area and water levels are controlled to meet the habitat management objectives. The impoundments and marshes are also used by wading



birds, shorebirds and marsh birds. The fresh-water marsh areas are also utilized by reptiles and amphibians and mammals including muskrats.



Ecological Resources (cont.)

7. Gunning Bedford School —Fields and Woods

The Gunning Bedford School site includes fields, scrub edge and coastal plain forests. The forest areas are part of the extensive riparian corridor of Dragon Run providing a wildlife

Courtesy Delaware Audubon



movement and habitat corridor, supporting native plant community diversity and protecting water quality of the wetlands and stream channels. There has been high bird species diversity observed in this area and the school site is part of the Christmas Bird Count program that annually surveys designated sites for winter bird diversity.



8. Fort DuPont State Park—River Edge and Marsh

The river edge along Fort DuPont contains a variety of coastal habitats and plant community types including tidal marshes (low and high), meadows, scrub and deciduous forest. This is an area that is known by birders for having a high diversity of water birds and land birds that can be viewed at different times including seasonal variation during migration periods.



9. Canal Lands Mount Laurel Geologic Formation—Fossil Deposits

Deposits from the dredging of the C&D Canal have been placed in dredge material spoil piles along the Canal. The deposits are from the Mount Laurel Formation which includes material deposited during the late Cretaceous Period approximately 65 to 85 million years ago. Fossils found in the formation include Belemnites, Mosasaurs, sharks and dinosaurs (Fossilguy 2004). Areas identified for viewing fossils occur in deposits located near the base of the Reedy Point Bridge immediately south of Delaware City.



Stakeholder Input

As a part of the eco-tourism project, an Ecological Restoration Sub-committee was formed to review the preliminary list of ecologically significant areas and also to review and approve the potential ecological restoration opportunities identified in Section 3. The sub-committee is made up of state, non-profit and private organization personnel responsible for natural resource conservation and land management. The members of the sub-committee are the local and regional experts on ecological resources of the area and represent the interests of the land owners, public resource agencies, and local citizen and volunteer groups.

The sub-committee reviewed and approved the initial list of ecologically significant areas and will consider these areas in the long-term planning and project development for the overall Dela-

ware City Eco-tourism Program. The committee's most immediate concern and focus is the identification of the need for ecological restoration. This is key to ensuring that the foundation of ecological resources for the eco-tourism area includes investments in ecological restoration and long-term care & stewardship.

Other Regional Sites

The eco-tourism project area is a focused area identified for the grant that funded this project. There is stakeholder recognition that over time the Delaware City Eco-tourism Program should take on a broader context linking the ecological resource tourism opportunities immediately around Delaware City to a larger network of natural lands, ecologically interesting areas, and environmental education sites in Northern and central Delaware.

There are a number of regionally important ecological sites, natural land and educational facilities outside the projection area, including:

- Augustine Wildlife Area
- Thousand-Acre Marsh
- Lums Pond State Park
- Chesapeake & Delaware Canal
- Red Lion Creek
- Reedy Island
- Port Penn Interpretive Center
- Cedar Swamp Wildlife Area
- Bombay Hook National Wildlife Refuge
- Upper Blackbird Creek National Estuarine Reserve
- Ft. Mott State Park, New Jersey

HISTORICAL AND CULTURAL FEATURES

Rich History

Delaware City has deep roots in the maritime history of the Delaware River in northern Delaware. The City traces it beginning back to 1801 when the Newbold family purchased a tract of land that became Newbold's Landing. The Newbold family drew plans for the town in 1826 and the establishment of the eastern terminus of the Chesapeake and Delaware Canal it became an operating point and a way station for many significant shipping related activities.

During the period of 1840-1880 a peach boom made Delaware City famous for popularizing peaches nationwide. Peaches shipped from the wharf in Delaware City reached many ports including Baltimore and New York. Fishing was a main industry and fish were processed and shipped from the town. Herring, shad and sturgeon were the main catch and sturgeon roe caviar was shipped to Germany and Russia. Hunting and trapping muskrat in the local marshes also provided a livelihood for residents. Other smaller industries included blacksmith shops, a carriage house, a grist mill, a sheet metal factory among others.

Today the Delaware City community is fortunate to have its rich history and architectural heritage still evident in the homes and other buildings in the town.



Delaware City Historic District

This is an historic district around the town's center represented by more than 250 structures. It is on the National Register of Historic Places. Existing structures date back to the earliest days of the town in the 1820s.



Fort Delaware State Park

This fort is located on Pea Patch Island in the Delaware River. Also on the National Register it was a Union fortress dating back to 1859. The fort was used as a Confederate prisoner-of-war camp during the Civil War. It was later converted to a State Park with a Civil War Museum and still functions as such today. The fort can be accessed by ferry boat service that departs from the park office along the docks in Delaware City.



Fort DuPont State Park

This fort began operations in 1863 as an auxiliary gun battery for Fort Delaware and was a principal defense structure for the Delaware River. The Fort itself was constructed in 1899 after Admiral Samuel Francis du Pont, a Civil War Naval Officer. During World War II two artillery installations were stationed there and German prisoners-of-war. After World War II it was no longer an active military installation. It is now part of Fort DuPont State Park managed and operated by the State for public access.



Chelsea Residence

This site is an historic home also on the National Register that has architectural style of Greek Revival period, Italianate origin. It is a single dwelling located along State Route 9 near the entry to Delaware City. This home dates back to 1848.



Battery Park Eastern Lock of the C&D Canal

There is a restored lock in the park from the original route of the C&D Canal and it is one of the few remaining intact locks in the United States. Battery Park traces its heritage back to 1814 when the Navy Department authorized the erection of a battery and fortifications on what was then known as Newbold's Point.



3. Ecological Restoration

RESTORATION OPPORTUNITIES

Ecological restoration is an important component of the early phases of the eco-tourism program to ensure natural system protection, restoration and management. The site investigation observations were used along with the GIS mapping and collaborator input to identify a list of ecological restoration opportunities. The kinds of ecological restoration opportunities include the following categories:

- Invasive plant control
- Meadow management and establishment
- Reforestation and afforestation
- Scrub/Shrub management
- Shoreline restoration and management
- Wetland restoration, enhancement and management

Ecological Restoration is:

“Ecological Restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed.”

—The Society of Ecological Restoration International

Identified Opportunities

The following ecological restoration sites were identified in the project area:

1. Pea Patch Island—Invasive Plant Control, Supplemental Reforestation
2. Grass Dale Center—Scrub and Meadow Management
3. Grass Dale Center—Wetland Restoration
4. Fort DuPont—Invasive Plant Control, Shoreline Restoration
5. Dragon Run Park—Invasive Plant Control for Shoreline & Woods
6. DE City Lands at Branch Canal—Invasive Plant Control & Wetland Restoration
7. DE River Shoreline—Shoreline Restoration and Management
8. Gunning Bedford School—Invasive Plant Control, Meadow Management and Reforestation
9. Governor Bacon Health Center—Native Meadow Establishment and Reforestation
10. Dragon Run Agricultural Lands—Reforestation, Meadow and Wetland Restoration

1. Pea Patch Island—Invasive Plant Control, Vegetation Management

The restoration opportunity for this site is based predominantly on the need for protecting and enhancing the important heronry resource. The recommended ecological restoration stems from the SAMP report identified needs and the current management concerns identified by DNREC Recreation and Parks biologists. The most significant restoration need is



to control invasive plant species on the island, primarily mile-a-minute weed (*Polygonum perfoliatum*). Other invasive species needing some control include common reed and purple loosestrife (*Lythrum salicaria*). The mile-a-minute weed is killing trees and inhibiting woodland regeneration that would otherwise provide the next generation of nesting trees for the herons.

Invasive plant control and vegetation management, including re-planting native woodland and wetland species, will not only improve the habitat conditions, but will also increase native plant biodiversity. Part of the island's shoreline has undergone extensive shoreline protection construction. There are additional areas on the west side of the island that are in need of shoreline stabilization.

Owner:	State of Delaware
Domain:	Public
Public Access:	Yes
Project Area:	~ 75 acres
Access Restrictions Necessary:	Yes
Proximity to DE City:	~1.2 miles

Ecological Restoration Opportunities:

- Invasive Plant Control
- Reforestation (and other native re-vegetation)
- Shoreline Restoration

Eco-tourism Activity Potential

- Bird Watching/Photography
- Historic Interpretive Tours
- Hiking/Guided Nature Walk
- Vegetation identification



Figure 3.1 Ecological Restoration Opportunities. The numbers correspond to those on pages 14-19.

2. Grass Dale Center—Scrub-Shrub & Meadow Management

The restoration opportunity for a portion of this site includes a combination of meadow management and enhancement, and scrub-shrub (low, woody, shrubs, seedlings, vines and herbs) habitat restoration. The combination of vegetative treatments can be designed to provide habitat complexity to continue to support avian species diversity. Open meadow areas have previously been maintained by DNREC, but available resources haven't afforded management of these areas recently. Invasive species control of abundant autumn olive (*Elaeagnus umbellata*) is also need. Decisions will need to be made regarding the amount and extent of various habitat types. This includes managing the succession of vegetation to re-establish



the meadow, promote woodland cover, or establish a scrub/woodland transition zone, to provide habitat variability for a host of species. More significant areas of native meadow restoration are possible in the fields along the road towards the C&D Canal that are currently cut for hay production. The fields in this area are of a slightly larger scale to support some of the more area-sensitive grassland bird species.

Owner:	State of Delaware
Domain:	Public
Public Access:	Yes
Project Area:	~ 23 acres
Access Restrictions Necessary:	Yes
Proximity to DE City:	~ 0.25 miles

Ecological Restoration Opportunities:

- Meadow Management and Establishment
- Scrub/Shrub Management

Eco-tourism Activity Potential

- Nature Trails
- Native Plant Walks
- Picnicking
- Bird Watching
- Biking
- Hiking



Ecological Restoration (cont.)

3. Grass Dale Center—Wetland System Restoration

Ecological restoration opportunities for this site includes the restoration of a degraded tidal marsh system, and addressing significant areas of invasive plant dominance by common reed. Additionally, tidal hydrology has been altered as a result of past canal construction activities, and there



is a large breach along one of the berms resulting in significant marsh erosion and loss of shallow water habitat. The recommended ecological restoration strategy involves repairing the breach, restoring the

tidal hydrology regime, common reed control and native revegetation with native brackish marsh plant species. Additional restoration design measures include restoring small tidal creek channels and shallow open water areas.

Owner:	State of Delaware
Domain:	Public
Public Access:	Yes
Project Area:	~ 81 acres
Access Restrictions Necessary:	Yes
Proximity to DE City:	~ 0.2 miles

Ecological Restoration Opportunities:

- Wetland Enhancement and Restoration
- Invasive Plant Control

Eco-tourism Activity Potential

- Wildlife Watching
- Fishing
- Hiking

4. Fort DuPont—Invasive Plant Control, Shoreline Restoration

This restoration opportunity addresses the ecological and physical disturbance conditions evident at the main shoreline access point at the end of Wilmington Avenue. Much of the shoreline has been stabilized in an ad-hoc way with concrete rubble and other debris. Considerable portions of the shoreline are dominated by the invasive common reed, particularly the high marsh zones along the upland edge. This site provides an opportunity to utilize



and demonstrate natural shoreline stabilization techniques with native structural components (e.g., a marsh toe stone sill) and tidal marsh establishment with native species. Additional areas of the marsh system and coastal plain woodlands require invasive species control.

lization techniques with native structural components (e.g., a marsh toe stone sill) and tidal marsh establishment with native species. Additional areas of the marsh system and coastal plain woodlands require invasive species control.

Owner:	State of Delaware
Domain:	Public
Public Access:	Yes
Project Area:	~ 64 acres
Access Restrictions Necessary:	Yes
Proximity to DE City:	~ 0.85 miles

Ecological Restoration Opportunities:

- Invasive Plant Control
- Shoreline Restoration

Eco-tourism Activity Potential

- Historic Interpretive Tours
- Bird watching
- Fishing
- Boating
- Picnicking

5. Dragon Run Park—Invasive Plant Control for Shoreline & Woods

The shoreline along Dragon Run within the park includes a riparian buffer area with abundant non-native plant invasion including multiflora rose (*Rosa multiflora*). The ecological restoration recommended for this site is to control the invasive plant occurrence and spread. This is needed along the Dragon Run channel & wetlands as well as in the adjacent coastal plain woodlands. The second component of this restoration approach is to re-establish native plant species to pro-



vide better wildlife habitat and enhance the riparian buffer zone, improve access to the Run and enhance the overall outdoor experience for visitors.

Owner:	Multiple (DE City; DE City Parks)
Domain:	Public
Public Access:	Yes
Project Area:	~ 18 acres
Access Restrictions Necessary:	No
Proximity to DE City:	~ 0.0-0.3 miles

Ecological Restoration Opportunities:

- Invasive Plant Control
- Reforestation
- Wetland Enhancement

Eco-tourism Activity Potential

- Kayaking/canoeing
- Fishing
- Picnicking
- Wildlife viewing

6. DE City Lands at Branch Canal—Invasive Plant Control & Marsh Restoration



This site will benefit from a comprehensive tidal marsh system restoration including invasive plant species control. The most predominant invasive species is common reed prior treatment of the common reed is evident. In addition to more invasive plant control, scrub-shrub and woodland buffer areas can be enhanced and shallow open water can be improved for wading birds

and waterfowl. Delaware City already has plans to restore this wetland system including establishing tidal hydrology control at the Branch Canal, re-establishing native marsh plant species, abating flooding potential for the adjacent residents, and protecting an historic Civil War African-American cemetery that is located in the wetland.

Owner:	Delaware City
Domain:	Public
Public Access:	Yes
Project Area:	~ 18 acres
Access Restrictions Necessary:	Yes
Proximity to DE City:	0.0 miles

Ecological Restoration Opportunities:

- Invasive Plant Control
- Wetland Restoration
- Tidal hydrology control
- Native revegetation

Eco-tourism Activity Potential

- Bird watching
- Environmental education



Ecological Restoration (cont.)

7. DE River Shoreline—Shoreline Restoration and Management

The ecological restoration potential for this area of shoreline includes removing rubble and other debris, stabilizing disturbance and erosion areas with native marsh plantings and buffering the shoreline zone with trees and shrubs where appropriate. These restoration measures are intended to improve the ecological function of the River shoreline for erosion control & water quality protection, wildlife habitat enhance-



ment and improving the aesthetics of the transition from upland to water.

Owner:	Multiple (DE City, DNREC, Valero)
Domain:	Public & Private
Public Access:	Yes/No
Project Area:	9 acres
Access Restrictions Necessary:	Yes
Proximity to DE City:	0.0 miles

Ecological Restoration Opportunities:

- Debris/Trash Removal
- Native Re-vegetation plantings
- Invasive plant control

Eco-tourism Activity Potential

- Kayaking
- Fishing
- Photography

8. Gunning Bedford School—Invasive Plant Control, Meadow Management and Reforestation



Ecological restoration opportunities at this site includes the improvement of wildlife habitat in the transition zone from the adjacent Dragon Run riparian area, and the management of lands and facilities of the school. Restoration potential includes controlling invasive plant species, planting native species for reforestation purposes and providing a diversity of habitat types including scrub edge successional transition to the woodlands. There are also large areas of existing mowed fields (not recreational fields) that provide opportunities to re-establish native meadow areas, control small-scale erosion areas and limit routine field maintenance.

Owner:	Colonial School District
Domain:	Public
Public Access:	Yes
Project Area:	~ 56 acres
Access Necessary:	Restrictions
Proximity to DE City:	~ 1.8 miles

Ecological Restoration Opportunities:

- Invasive Plant Control
- Meadow Management
- Reforestation

Eco-tourism Activity Potential

- Native Plant Walks
- Environmental Education
- Hiking
- Bird Watching

9. Gov. Bacon Health Center—Native Meadow Establishment and Reforestation



Restoration potential at this site provides an opportunity to convert large, intensively maintained mowed fields to lower-maintenance native meadow habitats for birds, butterflies and other beneficial insects. Certain areas provide an opportunity for native tree reforestation and enhancing woodland corridors to support upland wildlife needs including movement, cover and breeding areas.

Owner:	State of Delaware
Domain:	Public
Public Access:	Yes
Project Area:	~ 56 acres
Access Restrictions Necessary:	Yes
Proximity to DE City:	~ 0.3-0.5 miles

Ecological Restoration Opportunities:

- Native Meadow Establishment
- Reforestation

Eco-tourism Activity Potential

- Biking
- Walking/Running
- Fishing
- Boating
- Bird Watching

10. Dragon Run Agricultural Lands—Reforestation, Wetland and Meadow Restoration

This ecological restoration site includes large areas currently in agricultural production with intensive fertilizer and pesticide use. This site provides a large-scale reforestation opportunity to augment existing woodland stands to form a large-block forest corridor. This restoration can be used to provide habitat for forest dwelling wildlife including forest interior dwelling birds (FIDs). This large scale reforestation project can also be a localized effort to provide carbon sequestration to help offset impacts of fossil fuel use and global climate impacts. Other opportunities here include converting some of the agricultural fields to native meadows for birds, butterflies, other beneficial insects and enhancing native plant diversity. There is an additional opportunity to enhance farmed wetland areas and ditches to restore forested wetlands and establish wetland



swales (shallow depression channels) for wildlife habitat use and water quality protection. Another component of restoration in these areas is invasive plant control. A 285-acre portion of this site is already planned for restoration activities including reforestation plantings, invasive species control and deer management under Motiva's Conservation Easement and Land Restoration Project agreement.

Owner:	Valero
Domain:	Private
Public Access:	No
Project Area:	~ 808 acres
Access Restrictions Necessary:	Yes
Proximity to DE City:	~ 1.5 miles

Ecological Restoration Opportunities:

- Meadow Management and Establishment
- Wetland Enhancement and Restoration
- Reforestation
- Invasive plant control

Eco-tourism Activity Potential

- Guided nature walks
- Hiking
- Wildlife viewing
- Photography

Stakeholder Review

The Ecological Restoration Sub-committee reviewed the preliminary list of ecological restoration opportunities and provided input and additions to help form the opportunities identified above.

Ecological restoration projects will be implemented by the Delaware City Eco-tourism Program as appropriate partners and funding sources are identified.

Implementation Priorities

At an Ecological Restoration Sub-Committee

meeting guiding principles, or more specifically prioritization criteria, were identified for the future selection of ecological restoration projects for implementation. These criteria include the following:

- Site accessibility by the public
- Project scale to support ecosystem functions
- Priorities based on established eco-tourism approach
- Project site proximity to Delaware City
- Need for restricted public access (time or area)
- Site access control potential

- Project readiness for design and implementation

The Ecological Restoration Sub-Committee will review this draft report, and based on their final review of the proposed ecological restoration, priority projects will be identified for implementation. Final coordination of restoration opportunities priorities will occur with the full Eco-tourism Program Advisory Committee to establish the connection to the overall eco-tourism approach and implementation strategies.



Ecological Restoration (cont.)

FUTURE EFFORTS

Next Steps

The next step for selecting ecological restoration projects for implementation is for the sub-committee to make the final prioritization decisions. Beyond the concept selection, ecological restoration projects will need to undergo additional feasibility studies, preliminary design development and final construction document preparation. After project design and regulatory permitting approval the projects can be constructed. This will require establishing provisions for long-term monitoring and maintenance. In order to move forward with the design process project implementation support will need to be obtained. This support will need to come in the form of grants, endowments, donations, State and Federal funds, and municipal match contributions.

Anticipated Costs

The various ecological restoration approaches identified in this document require the necessary funding to implement them. In order to make decisions regarding available resources for restoration project implementation, an understanding of potential costs ranges is needed. The table below summarizes the typical costs ranges for the specific restoration types. A preliminary anticipated cost range will be developed for each of the identified projects for inclusion in the final draft of this report. This will be based on gaining an additional understanding of the types and relative amounts of restoration measures that may be employed at each of the sites. With these anticipated implementation cost ranges in hand, the Delaware City Eco-tourism Program can move forward with identifying funding sources and partners for project development and construction.



ECOLOGICAL RESTORATION TYPE	GENERAL COST RANGE
<i>Wetland Enhancement & Restoration</i>	<i>\$5,000 – 75,000/Acre</i>
<i>Reforestation Planting</i>	<i>\$2,000 – 15,000/Acre</i>
<i>Invasive Species Control</i>	<i>\$1,500 – \$6,000/Acre</i>
<i>Meadow Management & Establishment</i>	<i>\$1,000 – \$3,000/Acre</i>
<i>Scrub-Shrub Management</i>	<i>\$2,000 – \$6,000/Acre</i>
<i>Shoreline Restoration</i>	<i>\$ 100 – \$1,200/Linear Ft.</i>

Possible Funding Sources

Given the scope, scale and complexity of the ecological restoration projects it will take targeted efforts to acquire the necessary funding through partnerships and cost sharing. This is particularly true because the projects are located on private and public (municipal and state) lands and the implementation and management costs are long-term investments. A number of potential funding sources have been identified to finance ecological restoration projects. A list of the sources identified to date is provided below. Additional potential funding sources will be identified with project partners and collaborators.

GRANT OR FUNDING SOURCE	GRANT/PROJECT TYPE
<i>US Fish and Wildlife Service</i>	<i>North American Wetlands Conservation Fund</i>
<i>US Fish and Wildlife Service</i>	<i>Land Owner Incentive Program</i>
<i>DNREC Division of Fish & Wildlife</i>	<i>State Wildlife Grant Program</i>
<i>National Fish & Wildlife Foundation</i>	<i>Five-Star Challenge Grant Program</i>
<i>NOAA Fisheries Restoration Center</i>	<i>Community-Based Restoration Program</i>
<i>DNREC Community Involvement Advisory Council</i>	<i>Community Environmental Project Fund</i>