US Army Corps of Engineers
Philadelphia District

New Jersey Department of Environmental Protection

Barnegat Bay Ecosystem Restoration **Feasibility Study**

Draft Report

Volume 3

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SECTION 2- GIS Report
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APPENDIX J

Section 1

Data ID Survey

Barnegat Bay GIS Data Identification Survey
5/18/99

Versar has conducted a survey of potential Geographic Information System (GIS) data sources for the Barnegat Bay restoration site selection process. This survey has included:

(1) preliminary review of the data already available to the Corps of Engineers,
(2) telephone contact with individuals who may have data of use, and
(3) identification of additional potential data sources from recommendations and other leads.

This report summarizes the data identified, indicates whether or not they will be available in the time frame of the site selection study, and evaluates the impact of unavailable data sets. The Appendices include details of the current data sets reviewed, organizations with potentially useful new data sets, points of contact, and potential additional data sources. A list of acronyms is also provided at the end of the Appendices.

Background

The primary purpose of this survey was to identify digital data sets that would be available to support Corps of Engineers' (CoE) restoration projects in Barnegat Bay. The process of selecting potential restoration sites, currently envisioned to occur during Summer, 1999, will be detailed in a later report ("Approach Report") under this task. The process will generally consist of systematically screening the area of interest spatially using digital data in a GIS, conducting field visits to a selected subset of the potential sites found in the screen, and ranking and recommending sites based on restoration potential and other factors. The actual data required in the screening phase of the process will be determined by the specific restoration objectives and the most effective screening methodology for sites that would satisfy those objectives.

The restoration objectives currently established for this program fall into three general categories:

- Ecosystem Degradation and Habitat Loss
  - Freshwater Wetlands Restoration/Creation
  - Salt Marsh Restoration
  - Restoration of Abandoned Lagoons
  - Submerged Aquatic Vegetation (SAV) Restoration

- Fish and Wildlife Ecosystem Degradation
  - Restoration of Fishery Habitat
  - Waterfowl Habitat Restoration

- Secondary Concerns

Construction of Wildlife Viewing Platforms
Flood Reduction

Preliminary Data Requirements and Survey Summary

Based on very preliminary assessment of the objectives noted above, Versar has developed a list of core data sets likely to be required for the GIS screening phase of site selection. This is a working list for this preliminary report, and should not be considered to be complete. A more fully developed list will follow in the Approach Report. The table below indicates the status and source of each core data set as currently known. Additional data sets considered or identified in this survey are listed in detail in Appendix A and Appendix B.

Unless otherwise noted, all data sets should be "current". For general site-screening purposes it is sufficient for current to include maps created during the last 20 years. The most useful historical data sets will be 20 to 50 years older than the current map of the same feature.

The definitions of the entries in the table columns are as follows:

- **Core Data Set:** A brief descriptive name of the data set required.
- **Available:** If Versar has already obtained a copy of suitable data, or knows how to obtain it from a public source, the name of the source appears in this column. A question mark indicates that the source listed may not fully meet the requirement.
- **Probable:** If a data set is known to exist, but has not yet been obtained, the data source appears in this column. If the data source name is preceded by a question mark, the suitability of the data is still unknown (i.e. due to format, scale, or other compatibility issues).
- **No Source:** An "X" in this column indicates that a specific data set or source has not been identified.

Core Data Set	Available	Probable	No Source
Wetland Areas	NJDEP	NWI	
Salt Marsh Areas		NWI	
Abandoned Lagoons			X
SAV Habitat		Ocean Cnty, Rutgers	
Streams	NJDEP		
Flood Plains		Ocean Cnty	
Water Quality		USGS, EPA	
Dredging Areas		? CoE	

(esp. Intercoastal Waterway)			
Historical Marsh Areas			X
Historical Shorelines	NJDEP	Ocean Cnty	
Historical Wetlands			X
Overwashed Areas	NJDEP		
Land Use	EPA/USGS	USGS, Ocean Cnty	
Erosion	NJDEP ?		X
Runoff			X
Head of Tide	NJDEP		
Vegetation (esp. Phragmites)			X
Shellfish Areas	NJDEP		
Threatened and Endangered Species Areas	NJDEP ?	Natural Heritage	
Aerial Photographs, hard copy and digitized		? CoE, NJDEP	
CAFRA	NJDEP	Ocean Cnty	
Targeted Preservation Areas		Ocean Cnty, TPL (via Rutgers)	
Topographic Maps, hard copy and digital		USGS	
Navigation Charts		NOAA	
Bathymetry		NOAA, Rutgers	
Salinity		Rutgers	

Preliminary Conclusion: Assessment of Data Adequacy

Based on the data availability table above, it is likely that the GIS screening and field investigation phases of the site selection study can proceed as soon as the identified data are obtained and integrated into a suitable data library. At this point sources for the following data have not been identified:

- Abandoned Lagoons
- Historical Marsh Areas
- Historical Wetlands
- Erosion
- Runoff
- Vegetation Maps (species level)

If these data are not obtained, the accuracy of the targeting effort may be moderately reduced in local areas, placing a greater burden on the field investigation to obtain data for the feasibility assessment. However, it is doubtful that the data gaps will be significant enough to prevent identification of appropriate restoration targets. Historical land use and shoreline data, which are available, will contain basic information about lagoons, marshes, and wetlands that can be substituted for specific delineations. Field investigations can verify this information and make estimates of runoff potential and erosion characteristics, as well as determine vegetation. If necessary, runoff and erosion can be modeled from terrain data and vegetation cover can be determined with good accuracy from high resoultion aerial photographs.

Note that, as the specific site-selection approaches are developed, requirements for additional data sets may be identified.. We cannot fully anticipate these data set needs at this time, and will make such additional recommendations for data acquisition as are necessary in the Approach Report.

Appendix A: Review of Existing Data

A great deal of basic and special topic data is readily available from public sources and scientific investigations of the Barnegat Bay Estuary System. These data have been partially assembled by the CoE and provided to Versar for evaluation. The direct point of contact for these data has been Mr. Joseph Gavin.

The most broadly-based of these public data sets appear to be the GIS coverages available from the New Jersey Department of Environmental Protection (NJDEP). Therefore, we have conducted an initial review of the metadata for these data to estimate the extent to which the list of Core Data Sets can be filled from this source. Brief notes on the data described are below, grouped by potential utility in the site-selection process.

Note that there are several other data sets that are also available that may have equal or better information for use in the site-selection process. As the integrated spatial data base is compiled for site-selection, these data sets will be evaluated and incorporated as appropriate.

In Core Data List

cafra - *may be useful if the CAFRA designation incorporates specific regulations or political or P-R significance*. Coverage delineating the Coastal Area Boundary as per the Coastal Area Review Act (CAFRA)
cedar – *needed if protected species*. Delineations of wetlands containing Atlantic White Cedar
coast -1986 coastline/shoreline of New Jersey (1:24,000 scale).
dune - Dunes and overwash areas along the New Jersey shoreline
fww - Delineations and classifications of freshwater wetlands

hihaz - *may be useful for evaluating areas susceptible to erosion and wash-out, and determining restoration potential*. Coastal flood areas with velocity (wave action), from FEMA maps
histshre - Historic shorelines for the ocean-side counties (1836-1977)
hot - Head-of-tide points on watercourses
lakes - Hydrography polygons for New Jersey
oceitum - Integrated terrain unit (land characterization) for Ocean County
qq91 - Grid for "1991" quarterquad boundaries
quads91 - Grid for "1991" quadrangle (USGS topo sheet) boundaries
shelclas - *may be useful if coverage comes into Barnegat Bay*. Zones with shellfish harvest classifications ("Shellfish-growing water classification")
stco - County boundaries for New Jersey
stream - Hydrography line coverages for New Jersey

Potentially Helpful

bchnour - locations of beach nourishment (beach fill) projects
ccmp - *may be useful on a large-scale identification of relative monitoring station locations, but map accuracy is not verified or consistent*. Cooperative Coastal Monitoring Program (coastal water quality) monitoring station locations
dams - *needed, but the data set is not complete (includes 1319 of the approximately 1600 dams in the state; locations are estimated to be ±500 ft of actual)*. Dams in New Jersey
geonames - *may be useful if topo sheets aren't used for field maps*. Place names and features from USGS topo sheets
incdec - Profile delineations, coast line, and three-mile limit (attributes include "total number of inches erosion or accretion")
open91 - *may be useful, but accuracy is not verified*. Federal and State public open space and recreation areas
shorstrc - Shoreline structures along the New Jersey coastline (Atlantic and inland bays)
shortype - Shoreline types along the New Jersey coastline (Atlantic and inland bays)
stmun - Municipal boundaries for New Jersey
swl - *may be useful in restricting restoration potential*. Solid waste landfills in New Jersey
spcehs - Critical environmental and historic sites of the State Development and redevelopment Plan
splan - Planning areas of the State Development and Redevelopment Plan
spcenpt - Identified centers of the State Development and Redevelopment Plan (note that these are tentative center locations. They are not approved and should be ignored for specific planning purposes.)

Not Needed

airmon95 - The locations of continuous air monitoring sites, with an indication of whether contaminants are tested at that site (with flags in columns).

buritum -Integrated terrain unit (land characterization) for Burlington County (west of Ocean)
climmun - Annual daily temperatures (min, max, mean) and mean annual precipitation by municipality
condis - Congressional districts in New Jersey
hemlock - Delineations of Hemlock stands
histpurv - Water purveyor service areas
iron - Location of mines and pits (presumably, iron/mineral mines only)
legdis - Legislative districts in New Jersey
lump - *probably not useful (offshore)*. Coverage indicating the locations of the "Lump" and the Avalon Shoal
meritum - Integrated terrain unit (land characterization) for Mercer County (northwest of Ocean)
miditum - Integrated terrain unit (land characterization) for Middlesex County (north of Ocean, beyond Monmouth)
monitum -Integrated terrain unit (land characterization) for Monmouth County (north and northeast of Ocean)
resrvoir - *probably not needed*. Existing and proposed water supply reservoirs
sandgrav - *probably not needed*. Location of mines and pits (presumably, sand and gravel pits only)
somitum - Integrated terrain unit (land characterization) for Somerset County (northeast of Ocean, beyond Monmouth and Middlesex)
state - *probably not needed, because the area of interest (detail needed) is Ocean County*. Outline for the State of New Jersey
wsma - *probably not needed*. Water supply management areas (reservoirs)
offshr - *probably not needed (offshore)*. Delineations of offshore study areas
studies - *probably not needed (offshore)*. Delineations of nearshore study areas
traks - *probably not needed (offshore)*. Delineations of track lines for vibracore collections
vibpts - *probably not needed (offshore)*. Coordinates for vibracore collections
sewe and **sewf** - Existing and future sewer service areas
spcenln - Designated centers of the State Development and Redevelopment Plan and their community development boundaries

Appendix B: New Data Sources Identified

Based on phone contacts, the following data have been identified as available and potentially useful to the study. Full documentation for the data sets has not been received for evaluation; therefore, they are not yet ranked against the core data set requirements for the screening study. This list does not include standard data sets maintained by public sources, such as NWI coverages or USGS DLG layers. The point of contact for each data set or source is indicated in italics to the right. Contact details are included in Appendix C.

U.S. Fish and Wildlife Service
- List of Known Species in Ocean County — *Doug Adamo*
- Permitting Information (1997-1999) — *Eric Schrading*

The New Jersey Natural Heritage Program
- Rare and Endangered Species and Natural Communities Data: — *Tom Breden*
  - Data Base , Index Maps , Priority Site Maps

Rutgers University, Institute of Marine and Coastal Sciences — *Michael DeLuca*
- Beyond The Century Plan (Technical Report and Maps)
- Land Use/Land Cover
- Bathymetry (limited amounts near research areas)
- Submerged Aquatic Vegetation (SAV) Model

Rutgers University, Dept. of Civil & Environmental Engineering — *George Guo*
- Salinity Data (derived from conductivity and temperature)
- Current Velocity
- Tidal Elevation

Rutgers Univ./Cook College — *Richard Lathrop*
- Benthic Habitat
- Bulkheads
- Colonial Nesting Bird Island Ranking
- Filled Lands
- Level I & III Land Cover (1972, 1984, 1994/95)
- Mosquito Ditching
- Roads
- SAV (1970s, 1990s)
- Watershed and sub-watershed boundaries
- Trust for Public Land (TPL) maps in digital form

USGS, Water Resources Division — *Eric Evenson*
- Stream Gauge Data
  - Base Flow, Storm Flow; (2) Long Term Stns, (10) Short Term Stns
- Low Flow Characterization
- Back Bay Flood Warning Network Locations
- Water Quality Stations (12)
  - Full parameter suite; Surface, Groundwater; Available via Web
- Well Locations
  - Observation wells, Public Supply wells
- Water SupplyGroundwater Model
  - Surficial Aquifers and related GIS layers
- Drainage Basins above gauges
- GIS Coverage of 14 Digit Hydrologic Unit Code (HUC)
- 1986 Land Use/Land Characterization Data (Raster)
- 1972 Land Use/Land Characterization Data (Raster)

Ocean County Soil Conservation District *David Friedman*
Storm Water Basins (1,000) [Hard Copy Documents Only]

New Jersey Dept. of Environmental Protection (NJDEP) *James Joseph*
Hard Clam and Eel Grass Populations (1985-1987)
Distribution Charts ,Report (Hard Copy Only)

New Jersey Office of State Planning *Steven Karp*
New Jersey State Planning Data
1997: CD-ROM (received), 1999: CD-ROM available by 12/99
Wastewater Management Plan

The Trust for Public Land (TPL) *John Klevins*
The Century Plan: A Study of One Hundred Conservation Sites
in the Barnegat Bay Watershed (Hard Copy Only)
Beyond The Century Plan: Biological Studies and Land Conservation
of the Barnegat Bay Watershed (Hard Copy; Digital via Rutgers)

Ocean County Planning Board (Partial List) *Dave McKeon*

Highly Useful:
Barnegat Bay Watershed boundary
Various base maps of Ocean County, Boroughs, Townships, Municipalities
Stormwater outfall locations
Eel and Widgeon grass beds in Ocean County
Farmland preservation maps
Future growth in Ocean County
Historic shorelines map of the four coastal counties
Land use of Ocean County
Pinelands/CAFRA boundaries in Ocean County
Public water supply wells in Ocean County
USGS floodzones map for Ocean County
USGS quads and quarter quad numbers in Ocean County
Water quality management plan planning areas
Watershed delineation in Ocean County

Potentially Useful
Average annual precipitation map
Census tracts of Ocean County
Coastal evacuation routes in Ocean County
County owned underground storage tanks
Farmland soil classifications in Ocean County
Geology of Ocean County
Hazardous sites (22)

Hydraulic device locations in Ocean County
Landfills of Ocean County
Marina locations in Ocean County
NJDEP hazardous site adjustment project
Nuclear evacuation routes in Ocean County
Open spaces in Ocean County (3)
Proposed reservoir site in Brick Township
Recreational bathing sites (11)
Recycling facilities and household hazardous waste deposit sites
Sewer service areas of Ocean County
Sole source aquifer map legends
Southern Ocean County Landfill
State planning areas in Ocean County
State road maps in Ocean County
Subdivision and site plans information in Ocean County
Water utilities of Ocean County

Appendix C: Contact List and Potential Additional Data Sources

Doug Adamo
U.S. Fish and Wildlife Service
New Jersey Field Office
927 North Main Street, Bldg. D-1
Pleasantville, NJ 08232-1454

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New Brunswick, NJ 08901

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USGS, WRD
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West Trenton, NJ 08628

David Friedman
Ocean County Soil Conservation District
714 Lacey Road
Forked River, NJ 08731

James Joseph
New Jersey Dept. of Environmental Protection (NJDEP)
Division of Fish, Game, and Wildlife
Route 9, Mile 51
P.O. Box 418
Port Republic, NJ 08241

Steven Karp
Manager Geographic Information Systems and Cartography
New Jersey Office of State Planning
P.O. Box 204
Trenton, NJ 08625-0204

John Klevins
The Trust for Public Land (TPL)
New Jersey Field Office
1095 Mt. Kemble Ave
Morristown, NJ 07960

Dave McKeon
Ocean County Planning Board
P.O. Box 2191

Toms River, NJ 08754

Additional potentially useful data sets were mentioned by a number of the contacts with whom Versar talked. Contact points for these data were requested, if known. The following people may have access to additional data not in the above lists.

Dr. Kenneth W. Able
Dr. Frederick Grassle
Fred Douthit – U.S. Department of Agriculture
Harvey Simon – EPA Region II
Bob Scro – NJDEP - Director, Barnegat Bay Estuary Program
Walter Murawski – NJ State – Supervisor, Fresh Water Biologist
Jim Kirkenbach – EPA Region II – Historical Fisheries
Jim Mummin – NJ State – Bureau of Marine and Fresh Water
Alan Avery – Ocean County – Director, Department of Planning
Beverly Mazzella – NJ State – Natural Lands Trust (Steward)
Dennis Davidson – NJDEP – Green Acres (Steward)

Appendix D: List of Acronyms

CAFRA	Coastal Area Review Act
CoE	Corps of Engineers
DLG	Digital Line Graph
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
GIS	Geographic Information System
HUC	Hydrologic Unit Code
NJDEP	New Jersey Dept. of Environmental Protection
NOAA	National Oceanographic and Atmospheric Admin.
NWI	National Wetlands Inventory
SAV	Submerged Aquatic Vegetation
TPL	Trust for Public Land
USGS	United States Geological Survey

APPENDIX J

Section 2

GIS REPORT

Barnegat Bay GIS Data Set Report

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1.0 GIS DATA PROCESSING RECOMMENDATIONS

Versar initially conducted a survey of potential Geographic Information System (GIS) data sources for the Barnegat Bay Ecosystem Restoration Site Selection during the Spring of 1999 (Versar, 1999a). The primary purpose of this survey was to identify digital data sets that would be available to support U. S. Army Corps of Engineers (USACE) ecosystem restoration projects in Barnegat Bay. This survey included: (1) a preliminary review of the data already available to the USACE; (2) telephone contact with individuals who potentially had useful data; and (3) identification of possible additional data sources from recommendations and other leads.

The result of the survey was a working list of data sets that could be assembled to support ecosystem restoration site selection. The USACE reviewed and augmented this list prior to beginning the acquisition phase of the study. Acquisition began in September, 1999, with emphasis on a set of "core" data that were likely to be required for the GIS screening phase of site selection. During this acquisition phase, additional efforts were made to identify data that could contribute to the project.

The list of possible data sets provided by the USACE was deliberately inclusive. It was recognized that some data would not be available and that other data might not be efficiently processed or readily used with the core data. As data sets were acquired, therefore, they were screened for further utility in the site selection process. Processing priorities were developed based on discussions with the site selection team, initial work with the data already available, and information obtained during the data acquisition effort. This process also identified several additional data sets that would contribute to the site selection effort; they were added to the list.

Table 1-1 lists the processing recommendations made to the USACE on December 14, 1999 (Versar, 1999b). Each potential data set was assigned a recommended processing priority of **Essential** (if available), **Desirable** (if time permits), or **Not Recommended**. The status of the GIS data sets (e.g. acquired, requested, or no source identified) as of the date of these recommendations is indicated in the last column.

Based on the processing priorities, it was recommended that the evaluation phase of the data set study include the Essential data sets and such Desirable data sets as were available at that time. Versar also recommended that no further work be performed under this task on the Not Recommended data sets.

The USACE reviewed and accepted these recommendations. The subsequent data evaluation phase is described in more detail in the following sections. It is the primary purpose of this report to convey the results of the data set evaluation conducted during January, February, and March of 2000. It is important for the reader to bear in mind that the data set selection and evaluation were driven by the need to support the site selection effort expeditiously and cost effectively and do not necessarily reflect the intrinsic value of the data sets.

Table 1-1. Data set status and processing recommendations

Processing Priority	Barnegat Bay Data Set Categories and Types	Data Set Status
Essential	Abandoned Lagoons	Request from USACE
Essential	Aerial Photographs (B & W)	Request from USACE
Essential	TPL BB Gap Analysis Maps - Marsh	TPL via Rutgers; requested
Essential	TPL BB Gap Analysis Maps - Islands	TPL via Rutgers; requested
Essential	TPL Century Plan Sites & Ranking	TPL via Rutgers; requested
Essential	Bathymetry (Digital)	NOAA data in house
Essential	Colonial Nesting Bird Island Ranking	Requested from Rutgers
Essential	Dam Locations	NJDEP Ser1.Vol2. In House
Essential	Dredge Disposal Areas (digital)	Request from USACE
Essential	Dredge Holes: Historical & Current Conditions	Request from USACE
Essential	Dredging Areas (esp. Intercoastal Waterway)	Request from USACE
Essential	Flood Plains	NJDEP Ser1.Vol2. In House. OC request in progress
Essential	Head of Tide	NJDEP Ser1.Vol2. In House
Essential	Historical Marsh Areas	***No source identified. Derive from coastlines ?
Essential	Historical SAV areas	1970 & 1990 Requested from Rutgers
Essential	Wetlands - Historical	***No source identified. Possibly from hist. aerials if avail.
Essential	Land Use	NJDEP Ser1.Vol2. In House. OCELU.E00
Essential	Roads	USGS 1:100K. Downloaded. (NJ too general; USACE too detailed)
Essential	Salt Marsh Areas	NJDEP Ser1.Vol2. In House. Extracted from OCELU.E00
Essential	Salt Marsh Areas - Disturbed Wetlands	NJDEP Ser1.Vol2. In House. Extracted from Ocean\Fww.E00
Essential	Salt Marsh Areas - Tidal Waters	NJDEP Ser1.Vol2. In House. Extracted from Ocean\Fww.E00
Essential	SAV Habitat	1996 data: Eelgrass.zip from Ocean Cnty. In house
Essential	Shoreline - current	NJDEP Ser1.Vol2. In House. Extracted from COAST.E00
Essential	Shoreline - historical	NJDEP Ser1.Vol2. In House. OC in house
Essential	Spot Elevation Point	Request from USACE
Essential	Streams	NJDEP Ser1.Vol2. In House. OCEAN\STREAM.E00
Essential	Threatened & Endangered Species Areas	NJDEP - Download from Web
Essential	Topographic Maps (digital)	Download DRGs from NJGS
Essential	Vegetation -Phragmites	Requested from Rutgers
Essential	Watersheds (HUC-14)	USGS Export files in house
Essential	Wetland Areas	NJDEP Ser1.Vol2. In House. OCEAN\FWW.E00
Essential	Dunes & Overwash Areas	NJDEP Ser1.Vol2. In House. DUNES.E00

Table 1-1. (Continued)

Processing Priority	Barnegat Bay Data Set Categories and Types	Data Set Status
Desirable	Aerial Photography (color quarter-quads)	Can request from NJDEP if needed.
Desirable	TPL Beyond the Century plan. All base GIS layers	TPL via Rutgers; requested
Desirable	Bridges	***Source not confirmed. Inquire of NJDOT
Desirable	Coastal Flood Areas	NJDEP Ser1.Vol2. In House.
Desirable	Current Fish Abundance	***No source identified.
Desirable	Dredged Bank Area	Request from USACE
Desirable	Erosion	***Source not confirmed. May be on NJDEP Ser1.Vol2
Desirable	Filled Lands	Requested from Rutgers
Desirable	Historical Fish Abundance	***No source identified.
Desirable	Iron Mines	NJDEP Ser1.Vol2. In House.
Desirable	Mosquito Ditching	Requested from Rutgers
Desirable	Navigation Charts	Download as needed. Bathymetry may be sufficient.
Desirable	Parks	NJDEP Ser1.Vol2. In House. OPEN91.E00 May not include all.
Desirable	Point Sources (contaminants, sewer outfalls, powerplants)	TRI - in house; STORET - Request; PJM - in progress
Desirable	Runoff	***No source identified.
Desirable	Salinity	***No source identified. Some HC studies & NOAA maps.
Desirable	Sand & Gravel Pits	NJDEP Ser1.Vol2. In House.
Desirable	Shellfish Areas	NJDEP Ser1.Vol2. In House.
Desirable	Shoreline Structures	NJDEP Ser1.Vol2. In House.
Desirable	Shoreline Structures - flap gates ???	***No source identified - contained in NJDEP Shore Struct ?
Desirable	Shoreline Types	NJDEP Ser1.Vol2. In House.
Desirable	Targeted Preservation Areas	Requested from Ocean County
Desirable	Tidal Currents	***No source identified.
Desirable	Tide Gauge Data	***Have USGS coordinates, no data. Checking NOAA
Desirable	Vegetation - Atlantic White Cedar	NJDEP Ser1.Vol2. In House.
Desirable	Wastewater Treatment Plant Area	Request from USACE
Desirable	Water Quality	OC in house. Also use EPA/STORET ?
Desirable	Wave Action	NJDEP "High Hazard Line" in house. Sufficient ?
Not Recommended	Surface Water Course Centerline	Request from USACE if needed
Not Recommended	Vegetation - All	***No source identified. Some info from MRLC
Not Recommended	Wharf Area	Request from USACE if needed
Not Recommended	CAFRA	NJDEP Ser1.Vol2. In House.

Table 1-1. (Continued)

Processing Priority	Barnegat Bay Data Set Categories and Types	Data Set Status
Not Recommended	Dam Area	Request from USACE if needed
Not Recommended	Flora - General Aquatic Vegetation Area	Not required NJ land use more detailed
Not Recommended	Flora - General Land Vegetation Area	Not required NJ land use more detailed
Not Recommended	Jetty Area	Request from USACE if needed
Not Recommended	Mooring Facility Area	Request from USACE if needed
Not Recommended	Railroad Bridge Area	Request from USACE if needed
Not Recommended	Road Area	Request from USACE if needed
Not Recommended	Road Bridge Area	Request from USACE if needed
Not Recommended	Road Centerline	Request from USACE if needed
Not Recommended	Structure Existing Site	Request from USACE if needed
Not Recommended	Surface Water Body Area	Request from USACE if needed
Not Recommended	Surface Water Course Area	Request from USACE if needed
Not Recommended	Vehicle Parking Area	Request from USACE if needed
Not Recommended	Water Tank Site	Request from USACE if needed
Not Recommended	Wetland Area	Not required NJ land use more detailed

2.0 EVALUATION PROCESS

The processing priorities described in Section 1 reflect the initial screening for processing the available data sets into the GIS data set library for the Barnegat Bay ecosystem restoration site selection. The three designations were intended to be a first approximation to what a more detailed evaluation would show, and hence to help focus the effort of that evaluation. For example, data sets in the "essential" category would be first in line for a thorough evaluation, while "not recommended" data sets would most likely not be considered further unless additional information suggested that they be reclassified.

The detailed evaluation process itself was designed to critically evaluate and refine these initial screening results. This section of the report describes the formal framework developed for data set evaluation. This framework is generally applicable to any site selection effort requiring integration of diverse spatial data. In applying the framework (as described in Section 3), the specific selection goals become important in determining the ranking given to a data set in each evaluation category.

Table 2-1 defines the categories used in the initial screening and in the detailed evaluation of the data sets. The relations between the more specific adequacy evaluation levels and the general screening levels are also depicted. Each screening level has two adequacy levels that help describe the importance and usefulness of the data set. The screening and evaluation levels are intended to be flexible enough to allow data sets to be moved from one category to another as knowledge of the data improves or the site selection criteria are refined.

To derive the adequacy rating of a data set, the detailed evaluation used the factors shown in Table 2-2. These qualitative criteria addressed the potential of the data set to support site selection from three general perspectives: (1) basic factors that relate to the selection of the data set for use (Selection Criteria), (2) factors that help evaluate the analytical usefulness of the data (Refining Criteria), and (3) factors that involve technical constraints (Technical Criteria). Each criterion has three acceptance levels, which usually translate into highly usable (high rank), satisfactory (medium rank), and minimally usable (low rank). Details and exceptions are explained further in the notes section for each criterion.

There is no quantitative translation of the rankings on these criteria into one of the site selection adequacy levels in Table 2-1. In general, a minimally usable ranking on one criterion is likely to throw a data set into the not needed or rejected categories, while several highly usable rankings would be associated with data in the supporting and needed categories. Section 4 provides a summary of the adequacy levels determined from the evaluation results in Section 3.

Table 2-1. Evaluation Classes Used for Barnegat Bay GIS Data Sets	
Inclusion Screening Levels	**Site Selection Adequacy Levels**
Essential	Needed
Data are required for site selection.	*A critical data set for completing site selection, even if information is only suitable for qualitative use.*
	Supporting
	Data set supplies necessary quantitative base information or selection attributes that, in concert with other data, help define potential ecosystem restoration sites. Quality should be better than sufficient, and preferably high.
Desirable	Refining
Data will help analysis and ranking, but are not critical to selection.	*Includes additional ecological factors or geographic attributes that primarily help rank sites for ecosystem restoration potential. Quality may be lower than Supporting Data; use may be either quantitative or qualitative.*
	Resource
	A stand-alone, comprehensive data set that provides additional information on site context or landscape pattern. Primarily provides real-world background for qualitative human understanding of site potential (e.g. land use, bathymetry, or topos).
Not Recommended	Rejected
Data will present technical or analytical problems, or have no direct relevance to site selection.	*Unsuitable for use in this project for a specific technical or quality reason (e.g. processing effort required, missing attributes, incompatible scale).*
	Not Needed
	Have other equivalent data which meet selection criteria better, or data are not relevant to selection

Table 2-2. Evaluation criteria used for Barnegat Bay GIS data sets

	High Rank	Medium Rank	Low Rank	Notes
Selection Criteria				
Relevance to Site Selection	Required	Helps	Does Not Contribute	Considers site selection factors specified in Approach document
Relevant to Mapping Tasks	Fundamental	Orientation/Reference	Extraneous	Mapping tasks may include base maps, field maps, and presentation maps. Fundamental data support all three.
Level of Detail	Very Detailed	Adequate	Crude	Very detailed data may correlate with excessive processing or extraneous information.
Timeliness of Data	Current	Data/Historical	Out of Date	
Compatibility with Essential Data	Exact	Fuzzy	Qualitative Use Only	Factors include projection, registration, and scale.
Attributes	Useful for Site Selection	Not Useful for Site Selection	Missing	
Refining Criteria				
Importance as Ranking Factor	Very Useful	Somewhat Useful	Not Useful	
Impact of Factor on Restoration	High Impact	Some Impact	No Impact	
Ecological Information Content	Complements Other Data	Duplicates Other Data	None	
Level of Information Synthesis	Integrated Analysis	Single Factor	Raw Data	
Technical Criteria				
Meta Data	Complete	Basic	Insufficient	Basic metadata may need augmentation. Insufficient metadata prevents use.
Processing Requirements	Minimal	Tolerable	Excessive	
Familiarity and Ease of Use	Ready to Use	Work Required, but no major problems	Major Conversion/Editing/ Extraction Required	
Purpose, Design of Data Set	Synergistic with Site Selection	Tangential	Inappropriate or at odds with Site Selection Goals	

3.0 DETAILED ADEQUACY EVALUATION

3.1 APPLYING THE EVALUATION FRAMEWORK

The evaluation methodology described in Section 2 defines a hierarchical structure for ranking the available GIS data sets with respect to their importance to the site selection process. Table 1-1 summarizes the data sets that were to be considered, their availability at the start of the ranking evaluation, and the initial processing priority assigned to them. Using these priorities, the *essential* data sets were evaluated first, and the *desirable* data sets were included as time permitted, unless site selection activities required a different order.

The way in which a data set is ranked on each of the 14 criteria described in Table 2-2 depends to some extent on the scientific and other decision factors related to the kinds of sites being sought. For the Barnegat Bay ecosystem restoration site selection, several types of restoration opportunities were of interest, including freshwater wetlands, salt marshes, abandoned lagoons, submerged aquatic vegetation, fishery habitat, and waterfowl habitat (see Versar, 1999a). Initially, the site selection team provided a descriptive statement of selection factors for each restoration type (see Appendix B of Versar, 1999c). These were used as the guidelines for determining the specific evaluation factors (Section 3.2, below) for each criterion.

In addition, the site selection analysis was carried out concurrently with the evaluation. Although this is not required to apply the evaluation framework, it provided a more intensive look at the data and refined some of the selection factors. Thus, the specific evaluation factors are better defined, and the relevance and compatibility of the data sets are better understood, than might otherwise be the case.

3.2 SPECIFIC EVALUATION FACTORS

The data sets were evaluated in terms of the criteria given in Table 2-2. Each coverage, including its associated data tables, was evaluated as a unit. Specific factors considered for each of the 14 criteria were:

1. Relevance to Site Selection - Each essential data set had already been identified as a critical component of the site selection process, and thus would receive High rank, unless the data set proved to be less detailed, or less relevant, upon inspection.

2. Relevance to Mapping Tasks - the data sets considered highly relevant to mapping tasks contained features which provided field crews with landscape, habitat, and

access information. Data which indicated habitat quality or condition (e.g., bathymetry, or Natural Heritage areas), on the other hand, were used to promote the scientists' understanding of the habitats, and received a lower ranking in this category.

3. Level of Detail - Both spatial and informational detail were considered for this category; attribute data were slightly less important, but were considered in tandem with the associated data sets when evaluating overall detail. Generally, spatial data sets which were developed at a scale of 1:24,000 were given a medium rating for level of detail; point data and data which did not align well with the coastline (the essential data set; see entry number 5 for explanation) were usually given a lower rating.

4. Timeliness of Data - Most data sets had been recently developed, and were considered timely. If the dates for the accuracy of the incorporated features varied, or the dates were not very important to the particular type of data, the evaluation ranking was lower. Some data sets contained features derived from historical records; these data sets were given a medium ranking.

5. Compatibility with Essential Data - The Barnegat Bay site selection team decided that the coastline, provided in digital format by the NJDEP, would be the basic, essential data set for all spatial analyses conducted for the site selection tasks. The coastline (current shoreline) data set established the boundaries of the Bay in the GIS applications, and was subsequently used in the GIS to determine the spatial compatibility of other data sets. Generally, vector-based data sets were of the same spatial resolution as the coastline, and were given a high compatibility ranking. Most other data sets were given a medium ranking; for instance, data sets derived from historical records or raster-based information.

6. Data Attributes - The information associated with the spatial data assembled for the Barnegat Bay GIS data library often provided useful habitat data to the site selection team. Many data sets were initially selected because they incorporated both geographic location and biologically significant information; thus, most higher priority data sets received high and medium rankings in the evaluation stage. Medium rankings were usually given to data sets which only had single-value entries. Some data sets did not have sufficient metadata available with which to interpret the attribute information; the usefulness of these data could only be estimated.

7. Importance as a Ranking Factor - A data set's importance as a site selection ranking factor may have been obvious in the way the analysis called upon its attributes or measured proximity to other data. Some data sets include ranking in themselves (e.g., the Gap analysis), and could be used to support ranking in both the site selection processes and restoration potential assessments. In some cases, the usefulness of a data set for ranking-level assessments needed to be estimated, as the evaluations for the GIS data sets preceded the final ranking of sites for the site selection task.

8. Impact of the Factor on Restoration - Generally, the ranking given for this criterion was the same as the previous entry (importance as a ranking factor), unless specific restoration methodologies were being considered. The related issues which were considered in the assessments of restoration potential included access issues, stream and watershed associations, and site vulnerability (e.g., historic shorelines and overwash areas provide clues to fluctuations in the habitat around coastal sites).

9. Ecological Information Content - In most cases, if the data set had more than single-value attributes associated with it, it was considered to be a complementary data set (the data sets could thus be used in concert with each other to formulate procedures for using the GIS as tool for site selection). Data sets with single-value qualities were given a lower ranking for this criterion.

10. Level of Information Synthesis – Data sets such as the Gap analysis, Natural Heritage areas, and Land Use data sets, which represented the results of an analysis of multiple inputs, were considered highly integrated. Data sets with single-value attributes were given a low-level ranking (except for Historic shorelines, because of the work necessary to extract the data and translate them to digital form). All other data sets received a medium rank.

11. Metadata - Most metadata associated with the Barnegat Bay GIS data sets were basic (receiving a medium rank for this criterion), i.e. sufficiently detailed to be able to use the data sets with some confidence, or specifically accurate in critical entries which would determine the usefulness of the data set and its coordination with other files (for instance, dates of development, accuracy and scale of source data, definitions of field entries). Data sets with metadata that satisfied this basic level, and provided more information, were given a higher ranking; data sets with metadata which did not satisfy the basic requirements, specifically for use in the site selection process, were given a low rank.

12. Processing Requirements - All data sets required some processing effort to decompress files, re-project the spatial data, and interpret and implement the components of the metadata. With the exception of the bathymetry data set, all files were received and manipulated in a vector format.

13. Familiarity and Ease-of-Use - Similar to the processing requirements, all data sets required some investigation to learn about their qualities and compatibility with essential data. Again, the bathymetry data set presented a conversion problem (from image data to a format that the vector-based GIS could use - in this case, points with values, or vector boundaries for pixels with like values).

14. Purpose and Design - All data sets considered were either developed for ecological monitoring and assessments (high rank) or supported GIS mapping and analysis (medium rank).

3.3 EVALUATION RESULTS

The following table (3-1) contains evaluation rankings and descriptive notes for the data sets that were processed. For the most part, these were the data sets actually used or considered in the concurrent site selection effort. Consequently, this subset of the data originally listed in Table 1-1 includes all of the usable data that were highly relevant to site selection. Other data sets included were useful for field mapping (e.g. roads) or coordination with other maps and studies (e.g. TPL Century Plan sites).

For each data set, the table lists the ranking level for each criterion, followed by the descriptive notes. The ranking levels are High (H), Medium (M), and Low (L), as indicated in Table 2-2 and described in Section 3.2 above. Other codes used are: N/A – not applicable; Varies – if the data set has mixed character; Unk – if the level is unknown or cannot be evaluated, e.g. due to missing information.

Table 3-1. Data Set Evaluation

Original filename	Data type	Criteria and Ranking													
		Relevance to Site Selection	Relevance to Mapping Tasks	Level of Detail	Timeliness of Data	Compatibility with Essential Data	Data Attributes	Importance as a Ranking Factor	Impact of the Factor on Restoration	Ecological Information Content	Level of Information Synthesis	Metadata	Processing Requirements	Familiarity and Ease-of-Use	Purpose and Design
OCELU	Land use (Ocean County)	H	H	M	M	H	H	M	M	M	H (assumed)	L	H	M	M
		Notes: The land-use data set would not specifically apply to site selection, because of its pixel-based unit system, and is more commonly used as a resource, for context. The attributes associated with the OCELU data set reveal features types which are unavailable on a more detailed coverage; for this reason, the OCELU data set is used for site selection (by creating subsets of the base data of features which satisfy site selection criteria) and as a base resource in its entirety. (Note: the polygons used to represent the salt marshes were derived from this data set.)													
TRVEHRDS	Roads (Corps/ADR)	M	H	H	H	H	L	L	M	N/A	M	H	L	L	L
		Notes: The roads coverage is a set of data files which contain detailed features for paved and unpaved roads. In two ways, this data set is inappropriate for the mapping tasks. The roads line coverage is a very detailed data set, and has been provided in units (areas) which would need to be individually converted and recompiled to create a usable data set for mapping tasks. Secondly, the only attribute associated with the features is whether the road is paved. A more suitable roads coverage (USGS 1:100K source) was used in the mapping tasks (see Roads (USGS; 1:100K)).													
FWW	Freshwater wetlands	H	H	H	H	H	H	H	H	H	H	M	H	M	H
		Notes: The freshwater wetlands coverage is very detailed, relative to the coastline coverage (basic, essential data set), but all features are contained in one file, with minimum processing necessary to query the full data set and extract specific feature types. The attributes allow for both general and detailed (Cowardin-based) surveys.													
COAST	Current Shoreline	H	H	M	H	N/A	N/A	L	L	L	L	M	H	M	H
		Notes: The coast coverage is the basic, essential feature for the Barneget Bay site selection. It provides the geographic framework for locating and registering the other data sets for integrated analyses. All other coverages are compared to the 1:24,000 scale to establish geographic compliance with this feature. Attributes for the coast coverage are not necessary for this purpose.													
STREAM	Streams (Ocean County subset)	M	H	M	H	H	N/A	L	M	L	L	M	H	M	M
		Notes: The streams coverage is useful but not necessary to select sites, as most criteria do not involve the conditions of streams in the Barnegat Bay watershed. The streams are useful for the mapping tasks, in providing information regarding local features (for finding sites in the field) and water course direction and influence on site condition (for refining ecosystem restoration assessments).													
DUNES	Dunes and overwash areas	H	H	M	H	H	H	H	H	H	M	M	M	M	H
		Notes: The dunes coverage has sufficient detail to comply with the essential data set (coast), however the entire file is not needed for site selection or mapping tasks. Specifically, the attributes include an overwash type which is a required criterion for site selection efforts for salt marsh ecosystem restoration opportunities.													

Table 3-1. (Continued)

Original filename	Data type	Criteria and Ranking													
		Relevance to Site Selection	Relevance to Mapping Tasks	Level of Detail	Timeliness of Data	Compatibility with Essential Data	Data Attributes	Importance as a Ranking Factor	Impact of the Factor on Restoration	Ecological Information Content	Level of Information Synthesis	Metadata	Processing Requirements	Familiarity and Ease-of-Use	Purpose and Design
DAMS	Dams (point data)	L	L	M	Varies	H	M	M	M	H	M (assumed)	L	H	M	M
		Notes: The dams coverage provides useful information about the location of dams in the study area. This information may be used in refining steps, or in assessing ecosystem restoration potential, if the water course interruptions associated with dams are deemed relevant for specific sites. The attributes are not described sufficiently in the metadata to determine their usefulness.													
FLOOD	Flood-prone areas	L	L	H	Unk	H	Unk	M	M	H	H	L	M	M	M
		Notes: The flood-prone areas in the study area may be helpful in assessing the potential success for ecosystem restoration projects. The data set's attribute table contains a field, flood-prone, with 5 values, but the categories are not defined. Although the relative flooding potential can be surmised from the locations of the different categories, the data set should not be used beyond a qualitative mode without further documentation. The coverage aligns with the essential coast line accurately.													
HOT	Head of tide	L	L	L	M	M	M	M	L	H	M	M	M	M	M
		Notes: The head-of-tide coverage provides a resource for the site ranking process. For the site selection task, the data set would likely be treated as a single-factor feature (although the data set attribute table includes codes which indicate which method was used for determining the tidal characteristics for each site). The points coordinate fairly well with the tidal data set (plus, the water body name is included in the attribute table), but not precisely. The metadata allows for an error margin of 200 feet.													
HISTSHRE	Historic shoreline	L	L	Unk	M	L	M	L	M	H	M	M	M	M	M
		Notes: The historic shoreline coverage provides a resource for the site selection and ranking tasks. The data set may be used in a qualitative manner to incorporate shoreline stresses into assessments of ecosystem restoration potential for nearby sites. The coordination with the essential coast coverage is difficult to determine, without confirming that significant beach replenishment (and natural fluctuations) took place between the last year of the historical data and the date that the current shoreline was delineated. The spatial extent of the coverages limits its usefulness for Barnegat Bay studies since the linear features are only on the ocean side of the Long Beach and Island Beach areas.													
LAGOONS_1975	Lagoons	M	L	L	N/A	M	L	L	L	H	M	L	M	M	M
		Notes: The lagoons coverage offers point data, presumably for the centroid of the water body polygon represented in the data set. The site selection process includes an investigation of the feasibility of restoring abandoned lagoons. Although the attributes associated with the data set do not indicate the status of abandonment, the coverage may be useful in providing more information about the hydrology in the Barnegat Bay watershed.													

Table 3-1. (Continued)

Original filename	Data type	Criteria and Ranking													
		Relevance to Site Selection	Relevance to Mapping	Level of Detail	Timeliness of Data	Compatibility with Essential Data	Data Attributes	Importance as a Ranking Factor	Impact of the Factor on Restoration	Ecological Information Content	Level of Information Synthesis	Metadata	Processing Requirements	Familiarity and Ease-of-Use	Purpose and Design
MARSHHAB	TPL GAP analysis - Marsh	H	L	M	H	M	H	H	H	H	H	M	M	M	H
		Notes: The TPL Gap Analysis data presents an important set of integrated habitat information to the site selection process. The marsh habitat analysis guides the analysis process by identifying areas in need of ecosystem restoration (low and medium rankings), and areas which are stable and may provide habitat support to nearby or adjacent ecosystem restoration efforts (high ranking). The polygons available in the MARSHHAB vector data set were derived from raster-based data; therefore, accurate measurements of habitat area and proximity to other features in the GIS may not be possible. In these applications, some error margin would be expected. Other than "staircase" edges, the areas align with the essential data set (COAST) well, when the coastline is re-projected to the same specifications.													
ISLEHAB	TPL GAP analysis - Islands	H	L	M	H	M	H	H	H	H	H	M	M	M	H
		Notes: The TPL Gap Analysis data presents an important set of integrated habitat information to the site selection process. The island habitat analysis guides the analysis process by identifying areas which are capable of providing suitable habitat for colonial birds; areas of lower ranking nearby may suggest opportunities for more successful restoration potential based on proximity to a stable colony and faunal conditions. The polygons available in the ISLEHAB vector data set were derived from raster-based data; therefore, accurate measurements of habitat area and proximity to other features in the GIS may not be possible. In these applications, some error margin would be expected. Other than "staircase" edges, the areas align with the essential data set (COAST) well, when the coastline is re-projected to the same specifications.													
TPLCPLAN	TPL Century Plan sites and ranking	L	L	M	H	M	M	H	H	H	H	M	M	M	H
		Notes: The TPL Century plan sites are presented in this data set; ranking of habitat quality is not given. The attribute table is not complete, in terms of date purchased (which may have provided some insight into the stability of the habitat under protection). The locations of the areas, themselves, may contribute to the ranking of sites, in light of public awareness, protected status of nearby or adjacent areas, and the likelihood of a maintenance priority. The TPL regions did not align with the essential coast line exactly, but the differences are slight and should not affect the utility of the data set in the ranking stages.													
ISLEHAB	Colonial nesting bird ranking	H	L	M	H	M	H	H	H	H	H	M	M	M	H
		Notes: The Colonial nesting bird ranking is derived from the Gap Analysis - Islands data set. The evaluation for the Islands data set applies specifically to its usefulness for assessing the quality of waterbird habitat; thus, the evaluation criteria and assessments used to categorize the Islands data set are duplicated here.													

Table 3-1. (Continued)

Original filename	Data type	Criteria and Ranking													
		Relevance to Site Selection	Relevance to Mapping	Level of Detail	Timeliness of Data	Compatibility with Essential Data	Data Attributes	Importance as a Ranking Factor	Impact of the Factor on Restoration	Ecological Information Content	Level of Information Synthesis	Metadata	Processing Requirements	Familiarity and Ease-of-Use	Purpose and Design
SPOILS_PLUS	Dredge disposal areas	L	L	M	Unk	M	M	M	M	H	M	L	M	M	M
		Notes: The dredge spoil area coverage may provide useful information to the site ranking process. Ecological restoration potential may be influenced by the proximity to current U.S. Army Corps of Engineers dredge disposal sites. Metadata did not accompany the GIS data set, thus evaluating the attributes is limited to obvious entries (e.g., site name). There is a field name in the data set which suggests that a correlated EIS is available for each site. The information in the EIS (if available) may provide useful insight into the characteristics of the dredge material and times for disposal. The polygon features do not match the coastline exactly; accurate measurements of spoil area (using the GIS) and proximity to other features may not be possible.													
IMFDCSPL	IWW dredged bank areas	L	L	N/A	H	Unk	L	Unk	Unk	Unk	Unk	L	M	M	Unk
		Notes: The data file for IWW dredged bank areas may be usable for site selection or ranking, but requires additional information to determine its usefulness. There are five records in the attribute table (five polygons in the data file), but the values in the table are either zero or missing. The metadata (for file IMFDCSPL, not IMFDCSLP2 - the coverage name) does not define what a "dredged bank area" is (the polygons do not appear in an obviously navigable water body) or describe what the fields in the table should represent.													
LFHYPELS	Spot elevations	L	L	L	H	M	M	M	M	H	M	H	M	M	M
		Notes: The Spot elevation data set is a simple point coverage, with attributes that include the elevation at the site, in feet. The attribute table has many more fields, but the values are either zero or missing. The four-file coverage does not extend far enough to the west to cover the entire study area, but the data may be useful for qualitative evaluations in the ranking phase, where ground elevations may indicate the spatial extent of a possible ecosystem restoration area (for projects which would be sensitive to height or aspect) or the probability of success (in terms of estimated runoff speed and direction, or protection from the natural or man-made disturbances).													
SAV79V5M	Historical SAV areas (1979)	H	H	H	M	M	H	H	H	H	M	M	M	M	H
		Notes: The historical SAV areas (derived from photographs taken in 1979, aligned with USGS 7.5-minute topo sheets) are an important component of the SAV restoration site selection process. The attributes available in the data set provide useful information about the densities of the plant populations colonizing the SAV beds in recent history. This data set, used in conjunction with a data set of the current SAV delineations, should provide valuable insight into the shifts and losses which have occurred in the time between the two assessments. The polygons available in the SAVPOLY vector data set were derived from raster-based data; therefore, accurate measurements of habitat area and proximity to other features in the GIS may not be possible. In these applications, some error margin would be expected. Other than "staircase" edges, the areas align with the essential data set (COAST) well, when the coastline is re-projected to the same specifications.													

Table 3-1. (Continued)

Original filename	Data type	Criteria and Ranking													
		Relevance to Site Selection	Relevance to Mapping	Level of Detail	Timeliness of Data	Compatibility with Essential Data	Data Attributes	Importance as a Ranking Factor	Impact of the Factor on Restoration	Ecological Information Content	Level of Information Synthesis	Metadata	Processing Requirements	Familiarity and Ease-of-Use	Purpose and Design
EELGRASS	Current SAV habitat	H	H	H	H	H	H	H	H	H	M	L	M	M	H
		Notes: The SAV areas (considered current, although metadata is not available to indicate the mapping dates) are an important component of the SAV restoration site selection process. This data set, used in conjunction with a data set of the historical SAV delineations, should provide valuable insight into the shifts and losses which have occurred in the time between the two assessments. The attributes list only the major species type (of two varieties), and have limited use for ecosystem restoration activities; field surveys will probably be necessary to determine ecosystem restoration potential for desirable species.													
PHRAG949	Phragmites (1994-1995)	H	H	L	H	L	M	H	H	H	M	M	M	M	H
		Notes: The areas of Phragmites are an important component of the ecosystem restoration assessments for freshwater wetlands, salt marshes, and waterbird islands. Percent of Phragmites cover provides valuable information for determining the extent of degradation and the relative potential for ecosystem restoration. The Phragmites data set provides only information about the dominant species within each area, which may be an unnecessary detail (presence/absence may be sufficient). The polygons available in the PHRAG949 vector data set were derived from raster-based data (Landsat TM derivative); therefore, accurate measurements of habitat area and proximity to other features in the GIS are not possible. The resulting polygons are crude in appearance, yet are likely centered fairly accurately.													
BATHYMETRY	Bathymetry	H	M	M	Unk	M	H	H	H	H	M	Unk	M	M	M
		Notes: The bathymetry data set provides useful information for the site selection process, specifically for SAV bed restoration. The only attribute necessary is depth, and with the values' increments being in tenths of meters, the resolution is fine enough to contribute to the analysis. The point data set aligns fairly well with the essential coastline, to within approximately 150 feet. The documentation accompanying the NGDC Coastal Relief Model CD (the source of the bathymetry point data set) claims that each cell incorporates "a vast compilation" of soundings data; therefore, accuracy for depth, or timeliness of the data set, cannot be determined.													
NATHERITAGE	Threatened and Endangered Species areas	H	M	M	H	M	H	H	H	H	H	H	M	M	H
		Notes: The New Jersey Natural Heritage priority sites are being used to signify the threatened and endangered species areas. The data set aligns fairly well with the coast line, but accurate boundaries are not expected from a rare habitat delineation. The data set provides valuable information for the vulnerability of regions of the State (corresponding to the sensitivity to degradation, and possibly the tolerance for interference by ecosystem restoration efforts), and may encourage the restoration of adjacent areas, to help preserve or buffer the sensitive habitat. Caution: The data set attribute table contains text fields larger than 254 characters, thus, ArcView will not display the entire record (although the text is not corrupted in the dBase file); the data can be exported to Word (and possibly other word processing and reporting software formats) to view the entire contents.													

Table 3-1. (Continued)

Original filename	Data type	Criteria and Ranking													
		Relevance to Site Selection	Relevance to Mapping	Level of Detail	Timeliness of Data	Compatibility with Essential Data	Data Attributes	Importance as a Ranking Factor	Impact of the Factor on Restoration	Ecological Information Content	Level of Information Synthesis	Metadata	Processing Requirements	Familiarity and Ease-of-Use	Purpose and Design
HUC14	HUC-14 watersheds	H	M	H	H	M	M	M	M	H	M	H	M	M	M
		Notes: The HUC-14 watersheds may provide a resource for evaluating ecosystem restoration potential for degraded sites, or the extent of the benefits of ecosystem restoration. The coverage aligns fairly well, but not exactly, with the coastline.													
OPEN91	Parks and public lands	H	M	H	M	M	H	H	H	H	M	M	M	M	M
		Notes: The Open91 coverage contains features of State and Federal public open space properties. This information is being used as a "parks" layer, even though all park features may not be represented. The accuracy of the data set, relative to the essential coast line, varies across the region. Dates also vary for the information sources. The data set is used for the site selection process, despite the limitations on accuracy, due to necessity.													
N/A	Roads (USGS; 1:100K)	L	H	M	M	M	M	M	M	N/A	M	N/A	M	M	M
		Notes: For technical convenience, the standard USGS 1:100K roads coverage was selected as a base layer for the mapping tasks, and may contribute to ranking of sites, in terms of disturbance or accessibility issues, depending on the analysis. The roads files, when imported into separate layers, provide some flexibility for their use. In large-area maps, displaying only major (C1, C2) roads may be sufficient; in smaller-area maps, when accessibility requires a more detailed field site map to correspond to road maps used by field crews, the layers for the lesser roads (C3, C4) provide useful information. The study area required the conversion of five USGS roads files.													
ICWW	Intracoastal Waterway	M	M	M	Unk	M	L	M	M	L	M	M	M	M	M
		Notes: The New Jersey Intracoastal Waterway was traced from NOAA navigational charts to create this data set. The data set contains a line feature (a series of line segments) which may indicate the centerline of the Waterway. The line provides a useful guide to some of the areas of the Bay which would be maintained by the USACE, in dredging operations for navigation. Additional information would be needed to incorporate the width of the channel along the line, as the spatial analysis process for site selection requires a calculation of the distance of a potential site to a navigation channel.													

4.0 SUMMARY RESULTS

The detailed evaluation in Section 3 provides the basis for assessing the overall adequacy of each data set to support site selection for the Barnegat Bay ecosystem restoration project. Table 4-1 summarizes the evaluation information and adds our overall adequacy level designation (as defined in Table 2-1). Note that the data set names in this Table have been abbreviated somewhat for formatting purposes.

The order of the data sets in Table 4-1 is from high to low, based on the number of H, M, or L ratings recorded. This quantitative ordering is not necessarily indicative of the value of the data set to the site selection process. The qualitative notes in Section 3 were examined to designate the adequacy level, which is given in the last column. The abbreviations which are used for the level names are:

- NEEDED – A *needed* data set.
- SUPPT – A *supporting* data set.
- REFINE – A *refining* data set.
- RESRC – A *resource* data set.
- REJECT – A *rejected* data set.
- NOTND – A *not needed* data set.

If the reader is interested in using these data for other studies, the relevance of the site-selection-driven evaluation should be carefully considered. Some highly detailed and well prepared data sets may receive a “rejected” evaluation because they would be technically intensive to use at the scale of a Bay-wide screening survey, with little gain in the survey results. Other data may receive a “supporting” evaluation only because the data set contains qualitative information that can be visually associated with identified sites to guide the assessment and ranking of restoration potential.

Table 4-1: Evaluation Summary and Site Selection Adequacy Levels

Data type	Criteria and Ranking														Level
	Relevance to Site Selection	Relevance to Mapping Tasks	Level of Detail	Timeliness of Data	Compatibility with Essential Data	Data Attributes	Importance as a Ranking Factor	Impact of the Factor on Restoration	Ecological Information Content	Level of Information Synthesis	Metadata	Processing Requirements	Familiarity and Ease-of-Use	Purpose and Design	
Freshwater wetlands	H	H	H	H	H	H	H	H	H	H	M	H	M	H	NEEDED
Dunes&overwash areas	H	H	M	H	H	H	H	H	H	M	M	M	M	H	NEEDED
Current SAV habitat	H	H	H	H	H	H	H	H	H	M	L	M	M	H	SUPPT
Threat& End. Sp. areas	H	M	M	H	M	H	H	H	H	H	H	M	M	H	REFINE
Hist. SAV areas (1979)	H	H	H	M	M	H	H	H	H	M	M	M	M	H	NEEDED
Marsh GAP anal. (TPL)	H	L	M	H	M	H	H	H	H	H	M	M	M	H	REFINE
Island GAP anal. (TPL)	H	L	M	H	M	H	H	H	H	H	M	M	M	H	SUPPT
Colonial nest. bird rank	H	L	M	H	M	H	H	H	H	H	M	M	M	H	REFINE
Parks and public lands	H	M	H	M	M	H	H	H	H	M	M	M	M	M	REFINE
Land use (Ocean Cnty)	H	H	M	M	H	H	M	M	M	H	L	H	M	M	RESRC
Phragmites (1994-95)	H	H	L	H	L	M	H	H	H	M	M	M	M	H	REFINE
HUC-14 watersheds	H	M	H	H	M	M	M	M	H	M	H	M	M	M	RESRC
TPL Plan sites & ranks	L	L	M	H	M	M	H	H	H	H	M	M	M	H	REFINE
Bathymetry	H	M	M	Unk	M	H	H	H	H	M	Unk	M	M	M	SUPPT
Dams (point data)	L	L	M	Varies	H	M	M	M	H	M	L	H	M	M	REFINE
Spot elevations	L	L	L	H	M	M	M	M	H	M	H	M	M	M	REFINE
Streams (Ocean Cnty)	M	H	M	H	H	N/A	L	M	L	L	M	H	M	M	RESRC
Roads (Corps/ADR)	M	H	H	H	H	L	L	M	N/A	M	H	L	L	L	REJECT
Current Shoreline	H	H	M	H	N/A	N/A	L	L	L	L	M	H	M	H	NEEDED
Flood-prone areas	L	L	H	Unk	H	Unk	M	M	H	H	L	M	M	M	REFINE
Head of tide	L	L	L	M	M	M	M	L	H	M	M	M	M	M	RESRC
Dredge disposal areas	L	L	M	Unk	M	M	M	M	H	M	L	M	M	M	REFINE
Roads (USGS; 1:100K)	L	H	M	M	M	M	M	M	N/A	M	N/A	M	M	M	NEEDED
Intracoastal Waterway	M	M	M	Unk	M	L	M	M	L	M	M	M	M	M	REFINE
Historic shoreline	L	L	Unk	M	L	M	L	M	H	M	M	M	M	M	REFINE
Lagoons	M	L	L	N/A	M	L	L	L	H	M	L	M	M	M	SUPPT
IWW dredg. bank areas	L	L	N/A	H	Unk	L	Unk	Unk	Unk	Unk	L	M	M	Unk	REJECT

5.0 REFERENCES

Versar, 1999a. Barnegat Bay GIS Data Identification Survey. Letter Report prepared for the U. S. Army Corps of Engineers, June 9, 1999.

Versar, 1999b. Option A GIS Data Evaluation Process – Draft. Memorandum prepared for the U. S. Army Corps of Engineers, December 28, 1999.

Versar, 1999c. Barnegat Bay GIS Study: Watershed Analysis/Restoration Site Selection Approach Report. Technical report prepared for the U. S. Army Corps of Engineers, August 2, 1999.

APPENDIX J

Section 3

Site Selection Approach

BARNEGAT BAY GIS STUDY

WATERSHED ANALYSIS/
RESTORATION SITE SELECTION APPROACH
REPORT

Contract No: DACW61-95-D-0011
Delivery Order No: 59

Submitted to

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2 August 1999

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1. BACKGROUND

Pursuant to the Congressional resolution on Barnegat Bay, N.J. (September 14, 1995), the U.S. Army Corps of Engineers, Philadelphia District (The District) completed an expedited reconnaissance study identifying possible improvements in ecosystem restoration and protection. Specifically, the following problems (and associated objectives) were identified:

1. Ecosystem degradation and habitat loss
   - Freshwater wetlands restoration/creation
   - Salt marsh restoration
   - Restoration of abandoned lagoons
   - Submerged aquatic vegetation (SAV) restoration

2. Fish and wildlife ecosystem degradation
   - Restoration of fishery habitat
   - Waterbird habitat restoration
   - Creation/restoration of islands

Two additional concerns were identified that are not considered primary benefit categories (i.e., the optimization of a proposed project will not depend upon their associated objectives being satisfied):

3. Lack of safe public access to environmentally significant sites
   - Construction of wildlife viewing platforms

4. Bay flooding
   - Flood reduction

The New Jersey Department of Environmental Protection (NJDEP) was identified as a non-Federal sponsor.

As the District moves forward with the feasibility study phase of this project, there is a need to obtain more specific information on the geographic locations of high-priority restoration sites. At present, the Barnegat Bay Estuary Program (BBEP) is conducting a data synthesis that will ultimately be incorporated into a geographic information system (GIS) for the region. To meet the time schedule of the District feasibility study, however, the District needs to conduct a watershed analysis using existing data that can target high-priority restoration opportunities within the next six months, i.e., it must complete a "restoration site selection study." As a first step in this analysis, Versar is conducting this GIS screening and planning study to identify currently available GIS layers and recommend a practical watershed analysis approach. The results of this GIS study will be used to initiate the watershed analysis/restoration site selection study.

2. OBJECTIVE

This report describes Versar's recommended draft watershed analysis/restoration site selection approach for the Philadelphia District's Barnegat Bay Feasibility Study. This approach is based on the results of the GIS screening and planning study that were documented in the GIS Identification Letter Report submitted to the District on May 18. It is expected that this draft approach will be used by the District to draft a scope of work for the site selection task.

3. DRAFT APPROACH

The goal of this draft watershed analysis/restoration site selection approach is to identify the best opportunities for environmental restoration through District projects in the Barnegat Bay Estuary area. The approach should be comprehensive (requiring the use of GIS or other map information providing complete or nearly complete coverage of the area), fairly detailed (requiring field evaluation of sites), and practical (requiring a multi-step screening process using only the minimum effort needed at each step). The multi-step screening process needs to use available data and ecologically relevant criteria for assigning values to areas and sites. Because the goal is to identify restoration opportunities, a classification of different problem types will be used with separate criteria. These criteria will address both degree of degradation and potential for restoration benefit. The draft approach includes the following 15 steps:

1. Coordinate closely with the District and other interested parties
2. Identify District restoration goals for Barnegat Bay Estuary
3. Review available spatial data from GIS data set task (Option A)
4. Classify problem types/restoration opportunities
5. Conduct field visit to verify problem type characteristics
6. Develop criteria for identification of target sites of each type
7. Assemble data sets relevant to each type
8. Screen GIS/map data for target sites using criteria for each type
9. Adjust criteria if necessary to limit to 100 target sites for field investigation
10. Develop protocols for field investigation and obtain landowner permissions
11. Validate field protocols with the District and conduct field investigation
12. Assemble and review field data
13. Develop criteria for scoring/prioritizing target sites
14. Screen target sites for candidate sites with the highest restoration potential
15. Present intermediate results and submit final deliverables

Step 1. Coordinate closely with the District and other interested parties

A critical component of this project will be the coordination between the contractor, the District, and other interested parties. This will ensure that the diverse information available from multiple sources

is used and that the best expert knowledge is acquired.. The coordination step begins the project, but continues throughout the period of performance. Proposed activities include the following:

- X Attend meetings, produce minutes, and obtain approvals from the District at critical steps in the project.
- X Review previous studies (relevant historical information, scientific literature, and expert opinion) and results from the BBEP and other initiatives.
- X Attend a meeting convened by the District with BBEP principal investigators or the public, as appropriate.
- X Solicit opinions on the classification of problem types/restoration opportunities, criteria for GIS/map screening, protocols for field investigation, and final candidate site prioritization/selection.

Step 2. Identify District restoration goals for Barnegat Bay

The District reconnaissance report describes the general environmental situation in Barnegat Bay Estuary region and lists problem types of interest. The contractor will expand on this description with additional information on overall and watershed-level goals for the area that may inform restoration strategies for combining or prioritizing projects. For example, the planning process of the BBEP contains two "modules" with specific objectives, as well as other issues to be addressed in these modules:

<u>Habitat Module</u>

- X preserve and restore ecologically important habitat and open space
- X effectively manage living resources
- X minimize erosion
- X increase adequate public access

<u>Water Resources Module</u>

- X restore and maintain a productive ecosystem with no adverse effects due to pollution
- X ensure that edible seafood is safe for unrestricted human consumption
- X minimize health risks to contact water uses
- X eliminate adverse impacts of eutrophication, including hypoxia, resulting from human activities
- X provide a sustainable water supply to the human population without adversely impacting natural water regimes

Human Activities Issues

- X provide for the human enjoyment of Barnegat Bay watershed while maintaining ecosystem integrity
- X foster water-related recreation while preserving the economic viability of commercial endeavors
- X encourage sustainable methods of development, whereby human uses are accommodated within a framework of ecosystem protection
- X encourage the proper use and management of the natural and human resources within the watershed of Barnegat Bay

These objectives address the priority management issues in Barnegat Bay: nutrients, conventional pollutants, pathogens, human population growth, habitat loss/alteration, species loss/decline, fisheries loss/decline, introduced/pest species, freshwater inflow problems, and drinking water problems. Overall, the primary concern in Barnegat Bay is the input of stormwater and nonpoint source pollution into an estuary that flushes only once every 50 days. This low rate of flushing makes Barnegat Bay especially vulnerable to anthropogenic influences.

In addition to addressing major sources of degradation, stakeholders in the restoration of Barnegat Bay estuary are also concerned with preserving the most ecologically valuable areas that remain. A comprehensive identification of these areas has been compiled by The Trust for Public Land as part of The Century Plan: A Study of One Hundred Conservation Sites in the Barnegat Bay Watershed. Major habitat types in Barnegat Bay include SAV, barrier islands/sand bars, lagoon/shallow open water, shellfish growing areas, beach/dune (bare and vegetated), sand/mud/salt flats, salt/brackish marsh, freshwater marsh (tidal and non-tidal), forested wetland, freshwater lakes/ponds, grass/open fields, scrub/shrub, non-wetland forest, and riparian/riverine (forested and floodplain). Federally endangered and threatened species in Barnegat Bay include, among others, bald eagle, peregrine falcon, piping plover, roseate tern, Cope's gray treefrog, American chafseed, Knieskern's beaked-rush, sensitive joint-vetch, and swamp pink. Additional studies sponsored by The Trust for Public Land elaborate on The Century Plan and provide more insight into conservation areas that might benefit from nearby restoration activities.

Since the focus of this study is the identification of candidate sites for specific District projects, the following factors should be considered in developing study goals and site selection criteria:

- X sites with big problems, i.e., those that would produce the greatest benefits if restored
- X sites most conducive to restoration, i.e., those most likely to be successfully restored
- X sites with fish and wildlife habitat degradation, i.e., those where natural resources would benefit from restoration that would be sustainable over time

X sites whose restoration would benefit a large geographic region, i.e., those whose ecological linkages would most benefit ecosystem restoration

X sites within the Federal interest, especially those that meet the size threshold for cost-effective restoration by the District

X sites within the interest of the non-Federal sponsor (NJDEP)

To the extent feasible, the District will assign relative importance to study objectives so that proper trade-offs can be made. Specifically, such priorities can be used to allocate the number of target sites identified to different problem types/restoration opportunities according to their importance.

Step 3. Review available spatial data from GIS data set task (Option A)

The GIS study currently in progress has identified spatial data layers, both GIS and non-digital map information, that can be used for systematic site selection on a watershed basis. The District plans to obtain a complete GIS data set, including the appropriate data layers, by exercising Option A of the GIS study. That GIS data set will be reviewed to aid in developing problem types and restoration opportunities that can practically be identified.

Step 4. Classify problem types/restoration opportunities

The District reconnaissance report identifies two major problem types/restoration opportunities (numbers 1 and 2) with associated objectives, and two additional concerns (numbers 3 and 4) that are not considered primary benefit categories. Since each of these situations involves different kinds of degradation and lends itself to different solutions, the contractor must develop the appropriate information and criteria to address each.

1. Ecosystem degradation and habitat loss
   - Freshwater wetlands restoration/creation
   - Salt marsh restoration
   - Restoration of abandoned lagoons
   - Submerged aquatic vegetation (SAV) restoration

2. Fish and wildlife ecosystem degradation
   - Restoration of fishery habitat
   - Waterbird habitat restoration
   - Creation/restoration of islands

Two additional concerns were identified that are not considered primary benefit categories (i.e., the optimization of a proposed project will not depend upon their associated objectives being satisfied):

3. Lack of safe public access to environmentally significant sites

- Construction of wildlife viewing platforms

4. Bay flooding
   - Flood reduction

Step 5. Conduct field visit to verify problem type characteristics

Contractor staff will visit representative field sites to become familiar with the features they expect to be evaluating using GIS and map data. This is a critical step prior to developing criteria for designating the problem types and restoration opportunities being selected. These field visits will be coordinated with representatives from the District, NJDEP, and the U.S. Fish and Wildlife Service (USFWS). They will be conducted by the analysts and field investigators assigned to the GIS/map screening and field investigation steps. Most important is the opportunity for the analysts developing the screening criteria to relate different map features to in-field representations. Videotape recordings of certain sites (selected by agreement between the District and the contractor) will be made for viewing by analysts not visiting the field.

Step 6. Assemble data sets relevant to each problem type

This step requires that a variety of information, most in GIS, be assembled and reviewed to produce data sets for use in screening potential target restoration sites. The needed information will have already been made available through Option A of the GIS study and the data review in Step 3. GIS or non-digital maps will be used in a map overlay process to identify the coincidence of appropriate features. Maps of habitat types of concern (combinations of data layers that best predict habitat presence) will support much of the screening step. In many cases, aerial photography may be the best source for site characterization; elsewhere, it will be used to validate other GIS data and refine criteria for site screening. Where available, historical data will be used to identify environmental trends and habitat declines that might be addressed by restoration projects.

Appendix A lists key GIS and map data layers expected to be used in the target site screening step.

Step 7. Develop criteria for identification of target sites of each type

The most critical step in the screening process is the application of ecologically relevant and analytically practicable criteria for identifying sites. Initial criteria will be developed in the project scope of work (based on this draft approach) and modified through the coordination phase. The refinement and identification of other criteria will continue iteratively throughout the analytical phases of the project. Nonetheless, the contractor will coordinate closely with the District on the final criteria to be used. In addition to developing problem type criteria, all sites will be screened to determine their proximity to ecological sensitive sites identified in the NJDEP Natural Area Survey.

The GIS/map screening criteria should be as comprehensive as possible, but will be limited to available data. It is anticipated that a separate set of criteria will be developed for each distinct problem type/restoration opportunity. The specific criteria chosen will depend on the ecological situation involved and the information available. Where possible, the criteria will include parameters that can be incorporated into post-project monitoring to determine the effectiveness of the restoration effort. The following examples illustrate considerations in identifying criteria:

- sites with specific types of degradation (e.g., wetlands with *Phragmites* invasions)
- proximity of sites to existing natural areas, especially those with high ecological value, (e.g., parks and reserves)
- sites where remedies can be practically applied (e.g., tidal re-establishment)
- sites where restoration would provide additional functional benefits (e.g., protection of shorelines from erosion)
- areas where restoration of two or more problems could be addressed together (e.g., restoring SAV beds adjacent to a new salt marsh)
- sites where restoration would have the maximum benefit (e.g., most miles of fish spawning habitat opened with construction of fish passage structures)
- locations where habitats occurred historically
- habitat types that have experienced historic loss or have special values
- habitats with the greatest benefit to target species (e.g., waterbirds such as black duck, colonial nesting birds, and wading birds)
- lands in public ownership or otherwise amenable to project implementation

Appendix B describes potential criteria for the problem types/restoration opportunities likely to be addressed in this study. Where applicable, specific GIS layers or maps that include the feature to which the criteria will be applied are identified.

Step 8. Screen GIS/map data for target sites using criteria for each type

This step implements a map overlay process using GIS-based algorithms or manual methods to delineate areas that meet the criteria defined for each problem type/restoration opportunity. While it is preferable to evaluate the map overlays within the GIS, it may be more cost effective or expeditious to do some overlays manually. Depending on the GIS/map data layers used, broad areas, shorelines, streams, or specific sites may be identified. An essential step in this process is the development of practical naming conventions for the target sites identified.

Step 9. Adjust criteria if necessary to limit to 100 target sites

It is anticipated that the GIS/map screening task may involve more than one screening step to narrow the suite of target restoration sites to a practical number. Given the size of the area being considered and the resources available for field investigation, approximately 100 sites is proposed as the target number for field site investigation. This screening task is an iterative process involving refining criteria that were chosen as a first cut. If areas larger than individual sites are delineated in Step 6, a commensurately larger field effort will be included. Each such larger area will be considered as an the equivalent number of individual sites for the purposes of identifying a total field effort equal to 100 site visits.

Step 10. Develop protocols for field investigation and obtain landowner permissions

Field investigations will be required to confirm expected site characteristics and obtain the detailed site-specific information needed to prioritize and select the final candidate restoration sites. Detailed information for each site will be compiled in field data sheets and site photographs. Identification or confirmation of ownership for each site will also be completed. Each site will have a unique site identification number linked to geographic locations in the GIS files.

The approach to the field investigation will be confirmed by the District, but will likely include obtaining specific information on important biological and hydrologic/hydraulic conditions via teams representing the appropriate disciplines. The field investigation will use customized field sheets developed for this project. At the initiation of the field investigation, the contractor will meet with the District to calibrate responses. Narrative comments on the field sheets will be encouraged and field investigators will note any information that might be useful in the final selection of candidate restoration sites. The use of standard data fields will facilitate comprehensive quantification of problems and comparison among sites. Geographic Positioning System (GPS) equipment will be used to determine accurate locations for each site. All data measurements and analysis will be consistent with the state of the practice and will conform to U.S. Army Engineer Waterways Experiment Station (WES) or other District guidelines as appropriate. It is anticipated that different field data sheets will be required for several problem types, as indicated below.

The types of information collected during the field investigation will vary by the kind of habitat or problem type being evaluated. The following is a preliminary list of parameters to be measured. Appendix C includes example field data sheets for the field investigation.

<u>Wetlands</u> (freshwater and salt marsh)

- GPS Coordinates
- Project Type:
    a. Phragmites removal
    b. fill removal

   c. tidal re-establishment
   d. creation
   e. structure addition/removal
   f. other
- Present Land Cover/Uses (on and off-site)
- Dominant Vegetation
- Approximate Area of Proposed Site
- Approximate Quantity of Excavation Required (acre-feet)
- Construction Access:
   a. limited
   b. moderate
   c. accessible
- Structures Required/Describe
- Presence of Utilities
- Side Slope of Existing Site
- Hydrology Input to Existing Site
- Receiving Stream/Water Body
- Field Notes and Sketches

<u>Restoration of Abandoned Lagoons</u>

- GPS Coordinates
- Project Type:
   a. dike construction
   b. add/remove structures
   c. add fill for SAV
   d. improve tidal circulation
   e. other
- Project/Site Description
- Present Adjacent Land Uses
- Dominant Vegetation
- Average Water Depth at High Tide and Low Tide
- Water Circulation Pattern
- Water Quality Conditions
- Approximate Area of Proposed Site
- Structures Required/Describe
- Approximate Quantity of Fill Required for SAV Establishment (acre-feet)

- Site Access: Boat Only? Y/N a). limited b). moderate c). accessible Description:
- SAV Currently Present? Y/N Describe:
- Phragmites or Other "Nuisance" Species Present? Y/N Describe:
- Field Notes and Sketches

Submerged Aquatic Vegetation

- GPS Coordinates
- Transect Compass Heading
- Water Temperature
- Salinity
- Turbidity
- Total Suspended Solids
- Nitrogen Concentration
- Quadrat Data (number of grids where SAV present)
- Evidence of Wasting Disease
- Color of SAV (green, brown, mottled)
- Epiphytes (absent, light, heavy)
- Flowers (absent, present)
- Depth to Substrate
- Substrate Type (e.g., sand, sandy mud, mud)
- Species Present
- Field Notes

Waterbird Habitat Restoration

- GPS Coordinates
- Project Type:
    a. Phragmites/vegetation removal
    b. placement of dredged materials
    c. island expansion/creation
    d. planting of indigenous species
    e. other (describe)
- Project/Site Description
- Present Land Cover
- Are Wetlands Present? Y/N Describe
- Approximate Area of Proposed Site
- Approximate Quantity of Fill Material Required (acre-feet)

- Site Access for Boats - Are Shallows Present? Describe
- Species and Number of Birds Observed at or Directly Adjacent to Site
- SAV Present in Vicinity of Site? Y/N Describe
- Field Notes and Sketches

Construction of Viewing Platforms

- Information on appropriateness of new viewing platforms will be collected while visiting all other types of sites
- Identification of potential views of target species or viewscapes
- GPS coordinates
- Color photographs
- Field notes and sketches

Flood Reduction

- Information on flood factors and potential mitigation will be collected while visiting all other types of sites
- GPS coordinates
- Color photographs
- Field notes and sketches

Access to sites will follow formal procedures developed by the District; access should not be attempted if there is resistance on the part of the landowner. Each field team will be supplied with an official letter explaining the process.

Step 11. Validate field protocols with District and conduct field investigation

Once the protocols for the field investigation have been developed and approved by the District, the contractor will collect primary data at approximately 100 sites to more accurately characterize site conditions. This information will be used to confirm appropriateness for District restoration activities and to develop a priority list of projects likely to provide the greatest restoration benefit.

Prior to the field investigations, the contractor field teams will meet with the District in the field to confirm the investigation approach and calibrate field measurements. The field investigation should be completed by the end of September so that vegetation can be evaluated.

Step 12. Assemble and review field data

Following completion of the field investigations, the contractor will interpret and analyze collected information to determine priority sites with respect to the problem types and associated restoration opportunities initially identified. To the extent feasible, the parameters measured will be assigned standardized values to facilitate comparison among sites. At a minimum, each aspect of the field data will be assigned high, medium, or low values. These ratings will consider problem extent, problem severity, and restoration potential. The contractor will also evaluate the relative benefits of different prioritization approaches, including (1) ecologically linked restoration, (2) worst problem remediation, and (3) good site enhancement or expansion.

Step 13. Develop criteria for scoring/prioritizing target sites

To prioritize sites for restoration (the final candidate site selection), the contractor will develop threshold values for parameters measured in the field (e.g., appropriate slope for wetlands creation) and combine them into standard scores that can be compared across problem types and environmental situations. In addition, higher priority will likely be given to sites that score higher in more than one category. As with the GIS/map screening criteria for target sites, the contractor will coordinate closely with the District in the designation of these parameter thresholds. As before, some modifications to the thresholds may occur iteratively as the analysis continues. It is recognized that cost implications, real estate issues, and other factors may change the priorities at a later time.

At the same time, the contractor will develop a list of situations where the District would not choose to go forward. Such situations include the proximity to federally or state listed threatened and endangered species, presence of important historical or archeological features, or substantial stakeholder opposition. In these "show stopping" situations, restoration projects would not be considered viable at these sites.

The values assigned to the cells for each target site may include (1) presence or absence of condition, (2) the numerical score assigned in the field, or (3) a narrative rating (low, medium, or high) using the criteria described in the following section. In addition, an overall rating of restoration potential (low, medium, or high) will be assigned to each of the 100 field investigation sites. This rating essentially answers the following questions: "Would the project likely bring about an improvement in the condition of the environmental resource" and "Overall, would a restoration action be successful and cost-effective at this site?" Lastly, brief notes on each site will be provided in the site condition matrix to summarize the situation being evaluated.

Appendix D provides an example of a field site investigation matrix displaying parameters evaluated and their scores. This example is derived from the Buffalo Creek watershed site selection project and includes only flood control, aquatic stream habitat restoration, and wetlands creation opportunities.

Step 14. Screen target sites for candidate sites with the highest scores

Using the criteria developed for scoring/prioritizing target sites, the contractor will screen all target sites; ancillary data obtained during the field investigation, including field data sheets, field drawings, photographs, and notes, will also be used. If possible, all sites will be assigned a unique priority; if not, high, medium, and low ratings will be determined.

Step 15. Present intermediate results and submit final deliverables

This step involves activities to be conducted throughout the period of performance. The contractor will present the results of the following steps in meetings with the District and obtain approval for proceeding with subsequent steps:

- kickoff and develop goals and criteria for identification of target sites of each type
- screen GIS/map data for target sites and develop protocols for field investigation
- screen target sites based on field results for candidate sites with the highest scores

The contractor will prepare and submit interim draft reports summarizing the results of (1) the GIS/map screening, (2) field investigation, and (3) final candidate selection phases of the study. At the conclusion of the delivery order, the contractor will combine information from all interim reports into a final draft report. Following comment by the District, the contractor will make revisions and submit a final report.

APPENDIX A

KEY GIS/MAP DATA LAYERS FOR TARGET SITE SCREENING STEP

Based on the approach outlined in this document, Versar has modified the core data set list previously provided in the Barnegat Bay GIS Data Identification Survey report. The table below describes the status and source of each core data set in the modified list as currently known.

Unless otherwise noted, all data sets should be "current". For general site-screening purposes, current includes maps created during the last 20 years. The most useful historical data sets will be 20 to 50 years older than the current map of the same feature.

The definitions of the entries in the table columns are as follows:

- **Core Data Set:** A brief descriptive name of the data set required.
- **Available:** If Versar has already obtained a copy of suitable data, or knows how to obtain it from a public source, the name of the source appears in this column. A question mark indicates that the source listed may not fully meet the requirement.
- **Probable:** If a data set is known to exist, but has not yet been obtained, the data source appears in this column. If the data source name is preceded by a question mark, the suitability of the data is still unknown (i.e., owing to format, scale, or other compatibility issues).
- **No Source:** An "X" in this column indicates that a specific data set or source has not been identified.

Core Data Set	Available	Probable	No Source
Wetland Areas	NJDEP, NWI		
Salt Marsh Areas		NWI	
Abandoned Lagoons			X
SAV Habitat		Ocean County, Rutgers	
Streams	NJDEP		
Flood Plains		Ocean County	
Water Quality		USGS, EPA	
Dredging Areas (esp. Intercoastal Waterway)		USACE	
Historical Marsh Areas			X
Historical Shorelines	NJDEP	Ocean County	
Historical Wetlands			X
Dunes and Overwashed Areas	NJDEP		
Land Use	EPA/USGS	USGS, Ocean County	
Erosion	NJDEP ?		X
Runoff			X
Head of Tide	NJDEP		
Vegetation (esp. Phragmites)			X
Shellfish Areas	NJDEP		
Threatened and Endangered Species Areas	NJDEP ?	Natural Heritage Nature Conservancy	
Aerial Photographs (hard copy and digitized)		USACE, NJDEP	
CAFRA	NJDEP	Ocean County	
Targeted Preservation Areas		Ocean County, TPL (via	

Core Data Set	Available	Probable	No Source
		Rutgers)	
Topographic Maps (hard copy and digital)	USGS		
Navigation Charts		NOAA	
Bathymetry		NOAA, Rutgers	
Salinity		Rutgers	
BB Gap Analysis Maps		Rutgers	
Parks		USGS, NJDEP, Ocean County	
Iron Mines	NJDEP		
Sand and Gravel Pits	NJDEP		
Current Shoreline	NJDEP		
Shoreline Structures	NJDEP		
Shoreline Types	NJDEP		
Roads	USGS		
Bridges	NJDOT ?		
Historical and Archeological Features	SHPO ?		
Tidal Currents			X
Wave Action	NJDEP ?		
Current Fish Abundance			X
Historical Fish Abundance			X
Dam Locations	NJDEP ?		
Dredged Hole Locations and Attributes		USACE	
Coastal Flood Areas	NJDEP		

APPENDIX B

POTENTIAL CRITERIA FOR SCREENING PROBLEM TYPES/RESTORATION OPPORTUNITIES

The following criteria have been identified as potentially useful and will be developed further in Step 6 (Develop criteria for identification of target sites of each type) and ultimately applied during Step 8 (Screen GIS/map data for target sites using criteria for each type). For each objective the specific problem to be addressed and its likely solution are described. The "means" of identifying such sites is provided with specific data sources where known.

PROBLEM 1: ECOSYSTEM DEGRADATION AND HABITAT LOSS

Objective: <u>Freshwater Wetlands Restoration/Creation</u>

- Identify key coastal and inland freshwater wetlands that are currently degraded by phragmites or past fill operations for developments. Objective would be to restore sites that are adjacent to existing non-degraded wetlands, refuges, parks, preserves, habitat for known threatened and endangered species, and other ecologically valuable areas.

  <u>Means:</u> Use combination of recent low-altitude, color aerial photos, NJDEP freshwater wetlands maps (FWS data set), NWI maps, and TPL land cover mapping to identify sites. To prioritize, use proximity to parks, preserves, and other ecologically important areas; make use of The Century Plan of The Trust for Public Land, as well as NJDEP Heritage data to do this. Note also that the NJDEP IRON and SANDGRAV data sets could be useful for identifying some disturbed freshwater wetland sites. In addition, historic maps and photos would be useful for identifying trends/losses in freshwater wetlands throughout the watershed.

Objective: <u>Salt Marsh Restoration</u>

- Identify key mainland coastal marshes that currently possess extensive areas of phragmites. Objective would be to restore degraded salt marshes by eliminating phragmites, using a combination of tidal re-establishment (e.g., dike removal, tide gate removal, etc.), herbicide application, and controlled burning, as appropriate. Areas will ideally be adjacent to existing tidal (non-phragmites) marshes, and other ecologically valuable sites (parks, preserves, etc.).

  <u>Means</u>: Use combination of recent low-altitude, color aerial photos, NJDEP tidal wetlands maps, and other resources to identify and map extensive areas of phragmites. To prioritize, use proximity to parks, preserves, and other ecologically important areas; make use of The Century Plan of The Trust for Public Land, as well as NJDEP Heritage data to do this. Note that the TPL sponsored a Rutgers study producing salt marsh gap analysis maps that rank habitat quality throughout the watershed. Note that the NJDEP HOT data set might be useful in this task, for identifying the upper edge of mainland tidal areas.

- Identify areas where salt marsh restoration would protect shorelines from erosion. In some situations, restoration of natural vegetation can serve as an alternative to structural bank stabilization measures. Native vegetation could be established in areas affected by past erosion, and would provide a buffer against moderate wave action. In selected areas, a possible approach would be to use dredged materials, where allowed, to extend the existing shoreline laterally into shallow waters (avoiding existing SAV beds). Potentially, adjacent shallow water areas could be targeted for restoration of SAV. This approach could be targeted on areas where habitat values would be greatest (near existing marshes, preserves, etc.) and where tidal and wave conditions are appropriate within the estuary.

  Means: Examine past and present shoreline maps to identify areas of shoreline erosion or losses of fringing marsh. In addition to navigational charts and topographic maps, NJDEP has historic shoreline data/map back to 1830s, including 1930s through 1970s (HISTSHRE), which could be compared to present shoreline (in NJDEP COAST and or other data sets). Shoreline structures (SHORSTRC) and type (SHORTYPE) maps may also be useful. Evaluate degree of wave action and tidal currents to find conditions suitable for re-establishing vegetation; examine navigational charts to avoid areas too close to inlets, channels, and highly exposed stretches of open water with excessive wave action. At candidate sites, consider feasibility of installing temporary stabilization of restoration site (e.g., "biologs" and other natural products) until plants become well-established.

- Identify degraded areas of coastal shoreline where fill could be removed, for re-establishment of salt marsh. This would necessitate identifying appropriate sites for depositing this fill. Objective would be removal of existing disturbed upland conditions for re-establishment of vegetated salt marsh.

  Means: Use newest version of aerial photos to identify potential sites. Verify age of fill with historic aerial photos. Land cover mapping could also be useful for selecting these sites.

- Identify problem "overwash" areas where sand has over-topped and filled edges of existing tidal marshes (resulting from storm events) along the coast within the watershed. Objective would be to restore the natural tidal marsh dynamics. One approach would be to excavate the over-topped marsh edges to their original elevations and re-plant, if necessary. These sites could be prioritized using their proximity to parks, preserves, and other ecologically important areas. Overwash areas that are currently valuable wildlife habitats (e.g., nesting shorebird habitats) would not be considered for excavation. Sand removed from the marsh edges could be used in replenishing adjacent dunes, if appropriate. This could be used as

an additional important factor for selection of sites (i.e., overwash wetlands that also possess damaged dunes).

Means: Use a combination of the most recent low-altitude, color aerial photos and the NJDEP Dune data set to map overwash areas. Prioritization could be done using NJDEP data on park and preserve facilities (the Open91 data set may work for part of this), as well as NJDEP Heritage data for adjacent parcels with T&E species.

Objective: Restoration of Abandoned Lagoons

- Identify abandoned lagoons along the coastline of the Barnegat Bay watershed. The objective would be to improve the ecological condition of the lagoons and restore biological productivity. One possible approach would be to dike and flap-gate them to create freshwater systems. Another option would be to improve tidal circulation, plant SAV, and take other measures to improve their ecological functioning as saltwater habitats (this option could include the placement of dredged materials, if allowed, in the lagoon to establish conditions conducive for establishment of vegetation).

  Means: Use a series of low-altitude, color aerial photographs to determine the locations of abandoned lagoons along the coastline of the Barnegat Bay watershed. A series of two separate years of photographs would probably be adequate (e.g., mid-1970s and mid-1990s) for selection of these sites. It might also be helpful to use the USGS 7.5-minute topographical quadrangles in identifying these sites. Given the development history involved with this problem types, county planning information may be used to identify candidate sites.

Objective: Submerged Aquatic Vegetation (SAV) Restoration

- Identify specific areas of the watershed for restoring SAV beds. Prioritization would consider the extent of SAV affected by wasting disease and its role in limiting restoration. All shallow areas of the Bay should be prioritized; specific high-priority sites should be identified. Some of these areas might be done in conjunction with restoration of dredged holes (see below) or other tasks. It would probably be appropriate to target some restoration areas in the general vicinity of the current District and State-maintained portions of the navigation channel.

  Means: The District currently has survey data on current and historic SAV beds gathered by Versar and other sources. Presumably this data/mapping can be used for selecting the most appropriate, high-priority sites for restoration. Depending on the completeness of the data, Versar can also map current SAV within selected

portions of the watershed using low-altitude, color aerial photographs, if required (this would not be intended to provide SAV mapping for the entire watershed). It would also be appropriate to refer to the NJDEP SHELCLAS data set and other appropriate data on the location of shellfish beds in the vicinity of potential SAV restoration sites, so that these areas would not be disturbed by projects.

PROBLEM 2: FISH AND WILDLIFE ECOSYSTEM DEGRADATION

Objective: Restoration of Fishery Habitat

- Goal #1: Fish Ladders. Identify locations on all waterways within the watershed where fish ladders would be an appropriate remedy for re-establishment of anadromous fish. Two dams have already been identified for studying the opportunities for restoring anadromous and catadromous fish passage.

  Means: NJDEP studies identifying potential restoration sties will be used, in conjunction with historic and current records of anadromous fish abundance, for site selection. The USGS 7.5-minute topographical quadrangles may be helpful in identifying existing dam sites. Water quality conditions and other information on the suitability of upstream habitat for the target fish species (e.g., river herring and American eel) will be evaluated.

- Goal #2: Restoration of Dredged Holes. Identify locations of dredged holes throughout the Barnegat Bay watershed. The locations of approximately 30 dredged holes are known to the District. The restoration goal for these holes is the restoration of ecological condition and biological productivity.

  Means: The District is currently surveying the size and shape of existing dredged holes. Versar is in the process of collecting detailed field data at two holes (including ecological condition of surrounding areas) in anticipation of restoration activities. These data can be used to evaluate the likelihood of returning the hole to valuable benthic habitat or SAV (based on surrounding conditions). It may also be most prudent to concentrate the search to the vicinity of the current District and State-maintained portions of the navigation channel, to facilitate easiest transport of dredged materials for filling the dredged holes.

Objective: Waterbird Habitat Restoration and Island Creation

- Identify primarily upland islands that currently possess extensive phragmites cover, particularly in the vicinity of the District- or NJDEP-maintained portions of the navigation channel (and other places producing dredged material). Objective is to restore habitat quality on these islands and to create new beneficial islands, where allowed. One approach

would be to place dredged materials on the islands for creation of sandy, unvegetated nesting bird habitat. This could be done in conjunction with herbicide application or controlled burning (prior to dredged materials placement), to rid the islands of phragmites. Sandy sites should be designed to encourage nesting of bird species of special state concern (e.g., black skimmer, piping plover, least tern), and to discourage nesting of birds that NJDEP considers "nuisance" species, such as herring gulls. Sites with trees could be restored to enhance nesting opportunities for wading birds.

Means: Use combination of recent low-altitude, color aerial photos, navigation charts, and other resources to map potential candidate islands possessing phragmites in the vicinity of the current District and State-maintained portions of the navigation channel and other potential areas to be dredged. Studies sponsored by TPL have identified 61 islands in the Bay with habitat value for colonial nesting birds (ranked in five categories from lowest to highest). Lower value portions of these islands may represent opportunities for enhancing nesting habitat value, while restoring nearby aquatic habitats could improve the overall ecological condition of the area.

PROBLEM 3: LACK OF SAFE PUBLIC ACCESS TO ENVIRONMENTALLY SIGNIFICANT SITES

Objective: Construction of Wildlife Viewing Platforms

- Identify specific restoration projects within the watershed where construction of wildlife viewing platforms would be appropriate and feasible. Construction of platforms would be considered in conjunction with other restoration activities. The District has indicated that a structure may be appropriate on the west impoundment of the Edwin B. Forsythe National Wildlife Refuge should restoration activities be conducted there. In addition, it may also be appropriate to design and install signs identifying unique environmental elements for sites where wildlife viewing platforms are planned.

  Means: Incorporate public wildlife viewing platforms where appropriate in designs for freshwater and tidal wetlands projects proposed as part of this study. Design and install signs in areas to encourage compatible use.

PROBLEM 4: BAY FLOODING

Objective: <u>Flood Reduction</u>

- Identify projects that would result in reduction in inundation, wave impact, or other factors associated with flooding. Flood reduction would be considered in conjunction with other restoration activities These projects would presumably best be incorporated into the freshwater and tidal wetlands restoration projects (see above).

  <u>Means:</u> Gather information from local governments on flooding impacts and take problem areas into consideration when designing freshwater and tidal wetlands projects.

APPENDIX C

EXAMPLE CUSTOMIZED DATA SHEETS FOR USE IN THE FIELD INVESTIGATION

Wetland Site Data
Restoration of Abandoned Lagoons
Submerged Aquatic Vegetation Data
Waterbird Habitat Restoration

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: _____ **Date:**
GPS Coordinates: _____ **Crew:**
Photo Rolls/Frames: _____

Project Type: a) *Phragmites* removal b) fill removal c).tidal re-establishment d) creation e) structure addition/removal f) other (describe below)
Project/Site Description:
Present Land Cover/Uses (on and off-site):
Dominant Vegetation:
Approximate Area of Proposed Site:
Approximate Quantity of Excavation Required (acre-feet):
Construction Access: a). limited b). moderate c). accessible **Description:**
Structures Required/Describe:
Presence of Utilities:
Side Slope of Existing Site:
Hydrology Input to Existing Site:
Receiving Stream/Water Body:
Notes and Sketches:

Barnegat Bay Watershed Analysis
Restoration of Abandoned Lagoons

Location ID/Name: _____ **Date:**
GPS Coordinates: _____ **Crew:**
Photo Rolls/Frames: _____

Project Type: a) dike construction b) add/remove structures c) add fill for SAV d) improve tidal circulation e) other (describe below)
Project/Site Description:
Present Adjacent Land Uses:
Dominant Vegetation:
Approximate Area of Proposed Site:
Structures Required/Describe:
Average Water Depth at High Tide and Low Tide:
Approximate Quantity of Fill Required for SAV Establishment (acre-feet):
Site Access: Boat Only? Y/N a). limited b). moderate c). accessible **Description:**
SAV Currently Present? Y/N Describe:
Phragmites or Other "Nuisance" Species Present? Y/N Describe:
Notes and Sketches:

Barnegat Bay Watershed Analysis
Submerged Aquatic Vegetation Data

TRANSECT NO. ____

Crew _____
Date/time _____
Weather _____
GPS Location _____

Transect compass heading _____

Evidence of wasting disease _____

Water temp. _____ NTU _____
Salinity _____ TSS _____
Nitrogen Concentration _____

Quadrat #	1 (50 ft.)	2 (100 ft.)	3 (150 ft.)	4 (200 ft.)	5 (250 ft.)
Grids per quadrat SAV is Present					
Color **G**reen **B**rown **M**ottled					
Epiphytes **A**bsent **L**ight **H**eavy					
Flowers **Y**es **N**o					
Depth to substrate (feet)/ Substrate type					

Notes:

Barnegat Bay Watershed Analysis
Waterbird Habitat Restoration

Location ID/Name: _____ **Date:** _____
GPS Coordinates: _____ **Crew:** _____
Photo Rolls/Frames: _____

Project Type: a) *Phragmites*/vegetation removal b) placement of dredged materials c) island expansion/creation f) other (describe below)
Project/Site Description:
Present Land Cover:
Are Wetlands Present? Y/N Describe:
Approximate Area of Proposed Site:
Approximate Quantity of Fill Material Required (acre-feet):
Site Access for Boats - Are Shallows Present? Describe:
Birds Observed at or Directly Adjacent to Site:
SAV Currently Present in Vicinity of Site? Y/N Describe:
Notes and Sketches

APPENDIX D.

EXAMPLE OF A FIELD SITE INVESTIGATION MATRIX DISPLAYING PARAMETERS EVALUATED AND THEIR SCORES

[This matrix is derived from the Buffalo Creek watershed site selection project and addresses only flood control, aquatic stream habitat restoration, and wetlands creation opportunities. It is provided for illustrative purposes only.]

APPENDIX J

Section 4

Site Selection Report

BARNEGAT BAY ECOSYSTEM RESTORATION SITE SELECTION

FINAL REPORT

Contract No: DACW61-95-D-0011

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31 March 2000

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1. INTRODUCTION

This report presents the results of the "Barnegat Bay Ecosystem Restoration Site Selection" conducted by Versar in support of the U.S. Army Corps of Engineers (USACE), Philadelphia District, Planning Division, Coastal Planning Section.

1.1 BACKGROUND

Pursuant to the Congressional resolution on Barnegat Bay, NJ (September 14, 1995), the USACE, Philadelphia District completed an expedited reconnaissance study identifying possible improvements in ecosystem restoration and protection. Specifically, the following problems (and associated restoration objectives) were identified:

1. Ecosystem degradation and habitat loss
   - X Freshwater wetlands restoration/creation
   - X Salt marsh restoration
   - X Restoration of abandoned lagoons
   - X Submerged aquatic vegetation (SAV) restoration

2. Fish and wildlife ecosystem degradation
   - X Restoration of fishery habitat
   - X Waterbird habitat restoration
   - X Creation/restoration of islands

Two additional concerns were identified that are not considered primary benefit categories (i.e., the optimization of a proposed project will not depend upon their associated objectives being satisfied):

3. Lack of safe public access to environmentally significant sites
   - X Construction of wildlife viewing platforms

4. Bay flooding
   - X Flood reduction

The New Jersey Department of Environmental Protection (NJDEP) is the non-Federal sponsor.

As the USACE initiated the feasibility study phase of this project, it became apparent that there was a need to obtain more specific information on the geographic locations of high-priority restoration sites. At present, the Barnegat Bay Estuary Program (BBEP) is conducting a data synthesis that will ultimately be incorporated into a geographic information system (GIS) for the region. To meet the time schedule of the USACE feasibility study, however, the USACE conducted a watershed analysis using existing data to target high-priority restoration opportunities, in other words, a "restoration site selection@ for the Barnegat Bay ecosystem.

1.2 SCOPE OF THE STUDY

For the purposes of this study, the Barnegat Bay ecosystem is defined as Barnegat Bay itself and adjacent lands west to the Garden State Parkway (Figure 1-1). This boundary captures the Bay's estuarine environment and the tributary reaches most closely connected to it. The study area covers approximately 210,000 acres of Ocean County, NJ stretching from Point Pleasant and Bay Head in the north to Beach Haven Inlet in the south, and from Island Beach and Long Beach Island in the east to the Garden State Parkway in the west (Kennish and Lutz 1984).

The term "ecosystem restoration" refers to the rehabilitation or enhancement of ecological processes and fish, wildlife, and plant communities at the local ecosystem scale. In general, the purpose of this restoration is to return a specific site (and to the extent possible adjacent areas or entire subwatersheds) to natural functioning and sustainable conditions. It is anticipated that the cumulative effect of restoring local ecosystem conditions will contribute to an overall improvement of conditions with the Barnegat Bay ecosystem.

1.3 GOALS AND OBJECTIVES

On November 15, 1999, the USACE, Philadelphia District issued a delivery order to Versar for the Barnegat Bay Ecosystem Restoration Site Selection Project. This project was designed to meet the critical need for comprehensive GIS and field evaluations of restoration opportunities in the Barnegat Bay ecosystem. The goal of this project is to identify and obtain more specific information on high-priority restoration sites. This project builds on the Barnegat Bay GIS evaluation and planning study recently completed by Versar, the GIS database task currently underway at Versar, and other activities of the USACE.

To refine the general goal of identifying priority candidate sites, the following more specific objectives were applied to selecting sites:

- X Sites with substantial problems (i.e., those that would produce the greatest benefits if restored)
- X Sites most conducive to restoration (i.e., those most likely to be successfully restored)
- X Sites with fish and wildlife habitat degradation (i.e., those where natural resources would benefit from restoration that would be sustainable over time)
- X Sites whose restoration would benefit a large geographic region (i.e., those whose ecological linkages would most benefit ecosystem restoration)
- X Sites within the Federal interest, especially those that meet the size threshold for cost-effective restoration by the USACE
- X Sites within the interest of the non-Federal sponsor (NJDEP)

1.4 ROADMAP TO THIS REPORT

This report presents the objectives, methods, results, and conclusions of the seven phases of the Barnegat Bay Ecosystem Restoration Site Selection: (1) goals and objectives, (2) review of the history of degradation and assessment of the potential for restoration in the ecosystem, (3) the site selection approach, (4) the screening of sites with GIS map overlay, (5) recommendations of sites from resource agents and the public, (6) investigation of sites in the field, and (7) evaluation and scoring of candidate sites to determine their potential for restoration. These phases (equivalent to sections in this report) produce tables and maps of candidate sites listed in order of greatest restoration potential. Section 7 discusses the overall conclusions of the site selection and includes recommendations for prioritizing restoration activities. Conceptual approaches for certain projects are provided. Section 8 lists the references (publications and maps) used for this project. Meeting minutes, raw data in field sheets, photographs of the sites visited, and GIS data are provided as appendices.

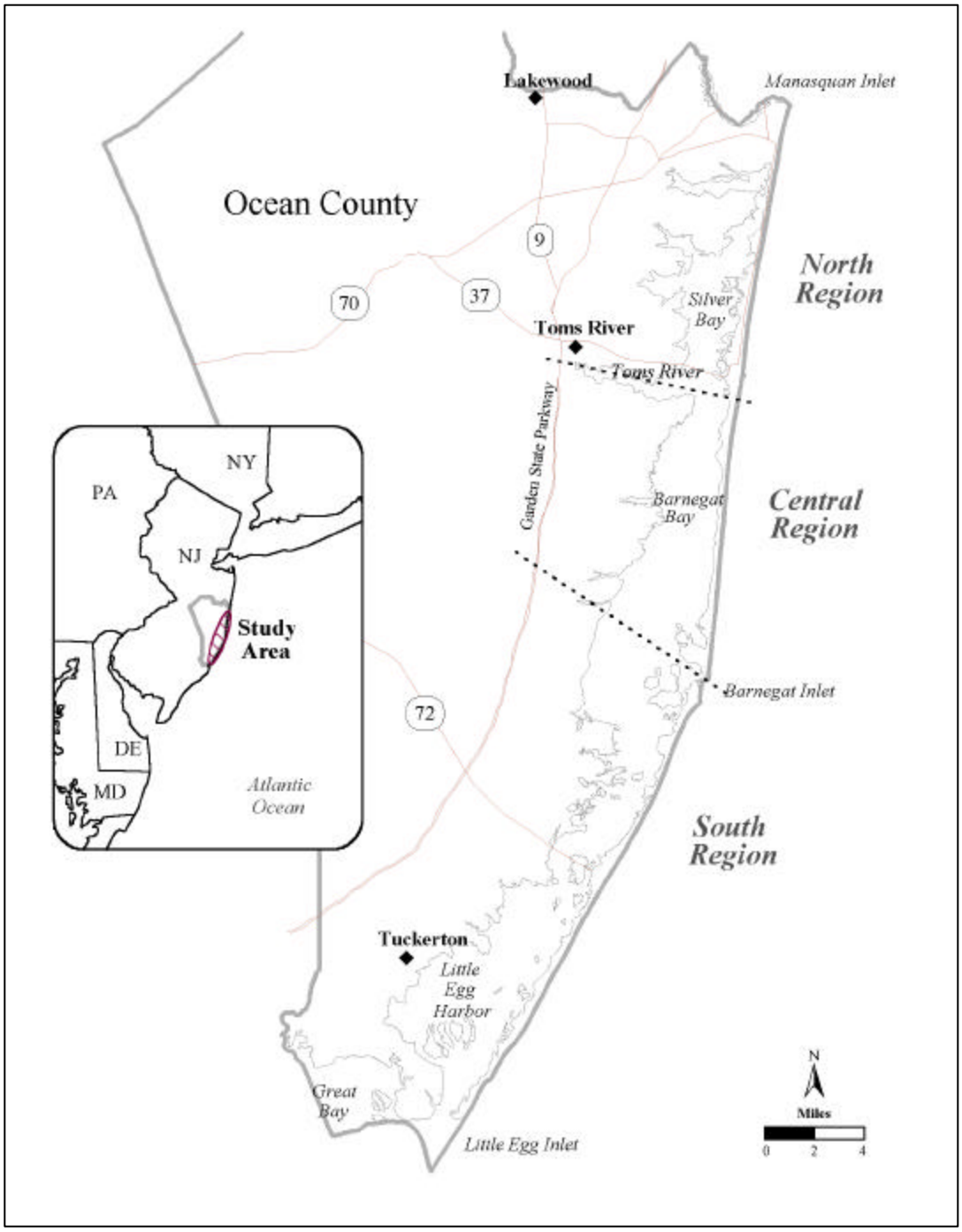


Figure 1-1. Location of the Barnegat Bay Ecosystem Restoration Site Selection study area within Ocean County, NJ

2. RESTORATION POTENTIAL IN BARNEGAT BAY ECOSYSTEM

The USACE reconnaissance study determined that there is substantial restoration potential in the Barnegat Bay ecosystem. Many other organizations and the public have reached the same conclusion and are addressing management and restoration needs through the BBEP. The extent and kind of restoration potential that exist are products of the history of degradation in the region. The kind of restoration that is most likely to be successful depends on the state of the science of restoration in coastal ecosystems. The following sections discuss the history of degradation in Barnegat Bay and the lessons in restoration that are most applicable to the opportunities in the ecosystem. This information was used in developing the screening criteria and evaluation process to select sites with the greatest potential restoration benefit in the Barnegat Bay ecosystem.

2.1 HISTORY OF DEGRADATION IN BARNEGAT BAY

Barnegat Bay has long played an important role in the history of the mid-Atlantic region of the United States. Much of this history has been documented by the BBEP in draft material prepared for its Characterization Report. The following summary of the history of degradation in Barnegat Bay is drawn from this material.

Following its discovery by Europeans in 1614, people gradually began to settle the coastline along the southern portion of the Bay, with the first community settling near present day Tuckerton in 1698. The northern portion of the Bay was more remote and was not settled until much later. In the late 1600s, there was little impact to the environment from human activities. By the beginning of the 1700s, lumbering activities stepped up to fuel sawmills and shipbuilding industries as settlements along the Bay=s western shoreline grew. By the early 1700s, lumbering activities had changed the landscape dramatically, resulting in the passage of the first regulations restricting timber harvesting by the Colonial General Assembly of New Jersey.

In the 1700s and 1800s, iron ore was extracted from the stream beds and surrounding areas. Iron furnaces were in operation 24-hours a day for seven to nine months of the year, stopping only when the streams were frozen. Streams were severely impacted during the iron ore extraction and the furnaces required large quantities of charcoal to fuel the fires. Vast areas of forest were cut down, using clear cutting methods, to supply the wood for charcoal kilns. Whole forests were removed, and, by 1865, only a few small charcoal operations remained.

The Bay is formed by a barrier spit and barrier island; ten inlets have allowed access to Barnegat Bay at various times in recorded history. Barrier islands are made of sand, and over time inlets open and close as sands shift. These inlets and their locations, have been responsible for growth and development in the Barnegat Bay watershed. By the 20th century, human activities related to this development began to noticeably affect the Barnegat Bay ecosystem. The railroad lines connecting the region to Philadelphia and New York launched a summer resort industry which sprung up around the Bay=s beaches and hunting and fishing opportunities

throughout the year. With an increase in the number of sportsmen drawn to the area, populations of waterfowl were dramatically reduced through hunting. Mosquitoes began to pose a serious threat to the increasing human population and, in 1908, New Jersey initiated the ditching and draining of meadows to reduce standing water, the elimination of bayberry stands, and the use of insecticides to control mosquito populations in the shore areas. The decline in mosquitoes reduced the food supply for mosquito-eating dragonflies and damselflies, and local residents observed declines in these species and higher trophic levels.

Fishing in Barnegat Bay has been conducted recreationally as well as commercially. Prior to the early 20th century, the west side of the northern portion of the Bay supported numerous freshwater species, including sunfish, yellow perch, pickerel, and largemouth bass. In the 1920s, the Point Pleasant Canal was opened, connecting the headwaters of Barnegat Bay with the Manasquan River to admit salt water into upper Barnegat Bay to convert it into oyster grounds and to provide a waterway for boats. The influx of salt water into the northern reaches of the Bay increased the salinity and lead to the replacement of freshwater fish species with estuarine species. The large numbers of oysters in Barnegat Bay and Little Egg Harbor supported a thriving oyster industry which lasted into the 1950s, when oyster populations crashed as a result of overharvesting, changes in the salinity regime, and disease. Hard clams, which require higher salinity, continued to thrive in the bay. The shellfishing industry transitioned from oysters to hard clams, and clam harvests peaked in the 1950s and 1960s. The hard clam industry has been in decline since the 1960s. As northern waters receiving fecal bacteria pollution were closed to clam harvesting, clam fishermen turned to the southern waters of the Bay. In addition to possibly diminishing stocks, clams from some areas are not marketable owing to the discoloration of the clam meat.

Beginning in the mid-1960s, the following issues have become major concerns in the Barnegat Bay ecosystem: nutrients, conventional pollutants, pathogens, human population growth, habitat loss/alteration, species loss/decline, fisheries loss/decline, introduced/pest species, freshwater inflow problems, and drinking water problems. Many Federal, state, and other groups are currently involved in addressing these priority management issues. Foremost among these efforts is the BBEP which is currently developing its Comprehensive Conservation and Management Plan (CCMP). During the last four years, the BBEP has instituted a public participation effort with citizens and other watershed stakeholders who live, work, and recreate in the Barnegat Bay area. A Citizens Advisory Committee was also formed to identify the issues and objectives of most concern to the citizens of Barnegat Bay watershed and to help define the focus of the plan. The goals and objectives obtained from this process are as follows:

- The Barnegat Bay estuary and its watershed will provide a healthy and naturally diverse habitat for fish and wildlife.
- The natural water cycle will be balanced to (1) protect the quantity and quality of public water supplies and (2) maintain or restore ecological conditions to support living aquatic resources in the estuary and watershed.
- Water quality in the estuary and watershed will support recreational bathing, direct shellfish harvesting, and the integrity of the freshwater and tidal benthic community.

- X Municipalities in the watershed will provide public access to waterways or shorelines to support multiuse recreation where appropriate.
- X All citizens and visitors will understand how they influence the natural resources of the estuary, its watershed, and the water cycle within it, and their role in its conservation and improvement.
- X The diverse users of the estuary and watershed will cooperate in the stewardship of the resources.

Another important initiative in the Barnegat Bay ecosystem is the development of *The Century Plan: A Study of One Hundred Conservation Sites in the Barnegat Bay Watershed* by The Trust for Public Land. This plan is a comprehensive listing of the ecologically valuable areas in Barnegat Bay most worthy of preservation. They include the following ecosystem types: SAV, barrier islands/sand bars, lagoon/shallow open water, shellfish growing areas, beach/dune (bare and vegetated), sand/mud/salt flats, salt/brackish marsh, freshwater marsh (tidal and nontidal), forested wetland, freshwater lakes/ponds, grass/open fields, scrub/shrub, non-wetland forest, and riparian/riverine (forested and floodplain). One objective of the plan is to preserve habitat to protect Federally endangered and threatened species including the bald eagle, peregrine falcon, piping plover, roseate tern, Cope=s gray treefrog, American chafseed, Knieskern=s beaked-rush, sensitive joint-vetch, and swamp pink.

2.2 STATE OF THE SCIENCE OF ECOSYSTEM RESTORATION IN COASTAL ECOSYSTEMS

The science of restoration ecology is relatively new, but the prospects for substantive improvements in damaged aquatic ecosystems are now very good. Although still largely fragmented, Federal, state, and local environmental programs have many restoration success stories to tell and are beginning to expand the spatial and temporal boundaries of their efforts. While we recognize that large-scale and long-term restoration projects are preferable, available resources limit the number and size of projects that can be undertaken in the short term. Therefore it is important that we give priority to the repair of ecosystems that would be lost without intervention (NRC 1992). Ecosystems that can be significantly restored with appropriate action should be given priority over ecosystems that will recover without intervention and those that cannot be restored to a meaningful degree even with extensive intervention. Establishing these priorities should be based on the expected ecological benefit and project cost (Southerland 1991).

How do we determine the expected ecological benefit of a restoration project? It depends on both (1) the expected condition of the ecosystem given its current condition and the restoration activity planned and (2) the likelihood of success of the restoration plan. Given the inherent uncertainty associated with ecosystem restoration, the actual ecological benefits can only be determined by conducting post-project monitoring using appropriate performance indicators. The following discussion presents the state of the science for the ecosystem types considered in the Barnegat Bay Ecosystem Restoration Site Selection. This information was incorporated into the selection and evaluation of potential restoration sites for this report.

2.2.1 Tidal and Nontidal Wetlands

Historically, tidal and nontidal wetlands in Barnegat Bay (as well as nationally) have declined because of physical alterations that changed the topographic and hydrologic characteristics that support them. The losses in wetlands area and functioning decrease or eliminate their capability for abating flooding and providing fish and wildlife habitat. Tidal wetlands are characterized by the tidal cycle (including both marine and freshwater types) and salinity gradients, which in turn determine the distribution of plant and animal species. Extensive degradation of tidal wetlands has resulted from diking, filling, and ditching for mosquito control or development. Most tidal wetlands restoration efforts have involved either the breaching of dikes to allow the reentry of tides or the restoration of vegetation after development projects. Canals and dikes have also been filled to restore wetlands on both small and large scales.

The status of scientific knowledge about wetland restoration and creation differs by wetland type, function, and location. Of all the kinds of aquatic ecosystem restoration, the most research and practice have involved coastal and estuarine wetlands, especially the tall cordgrass *(Spartina)* marshes of the Atlantic coast, such as those found in Barnegat Bay (Kentula 1999, NRC 1992). More success in restoring wetlands vegetation has occurred in these systems than in any other. This success is founded on the greater breadth of experience in tidal wetlands restoration and the relative ease of designing restoration projects. The primary determinant of restoration design in tidal wetlands is the appropriate elevation and this can be obtained from tide records and adjacent reference sites. In general, fewer wetland plant species occur in these systems (i.e., only those that are salt tolerant) than in comparable freshwater wetlands. At the same time, it is still uncertain whether the full suite of functions provided by a particular wetland type can be replaced. Full functional replacement has not yet been demonstrated. Much is known about the replacement of flood storage and waterfowl habitat; less is known about water quality improvement and groundwater-associated functions. In general, the more complex the hydrology and ecology of a system, the more difficult it is to restore the system. Wetlands restoration is almost always more likely to succeed than wetlands creation, but complete restoration may still be impossible in some systems.

Techniques for restoring wetlands fall into three broad categories (NRC 1992): (1) reestablishing or managing wetland hydrology, (2) eliminating or controlling chemical or other contaminants affecting wetlands, and (3) reestablishing and managing native biota (possibly by controlling nuisance species). In Barnegat Bay wetlands, restoration of the natural hydrological regime (usually by returning the wetland to its original topography and connection to tides and streams) and reestablishment of native plants are the primary needs. In most cases, fill material needs to be removed or dredged areas filled. The reestablishment of native biota most often will involve controlling *Phragmites australis,* the invasive common reed, also known as phragmites, and replanting native species (e.g., *Spartina* spp. in salt marshes and threesquare and other plants in freshwater wetlands). Although the ultimate goal is a self-sustaining ecosystem, some management may be necessary in the initial phase of restoration (e.g., stabilizing hydrology to assist in plant community establishment). In most cases, the emphasis will be on planting vegetation, assuming that the establishment of native fauna will follow.

While we might wish for a restoration project that closely approximates the predisturbance ecosystem conditions that are persistent and self-sustaining (while still dynamic in composition and functioning), there are often constraints to achieving complete restoration success. The most important of these are (1) the degree of disturbance to the site and its landscape, (2) ecological constraints (such as successional dynamics of the community), (3) biological constraints (e.g., on threatened species or posed by invasive species), and (4) institutional constraints. While many of the New Jersey coast salt marshes are highly disturbed urban systems, some parts of Barnegat Bay suffer an intermediate degree of disturbance. The urban marshes exist in heavily modified landscapes, leaving few refuges for native species and little opportunity for reestablishment of the total plant and animal community. The less disturbed marshes, however, often exist in conditions where simply closing ditches may allow the resumption of natural wetlands functioning. Fortunately the ecological constraints on tidal wetlands are less than on other systems. In particular, the growth of smooth cordgrass (*Spartina alterniflora*) in Atlantic coast marshes is rapid (because it expands vegetatively). Broome (1989) has stated that Aa smooth cordgrass stand established on sand in an area where natural marshes are relatively young will likely be comparable to the natural marsh for most measurements in a few years.@ On the other hand, many rare, threatened, and endangered wetlands species have complex or narrow ecological requirements. We cannot yet predictably restore wetlands to support these species. While the invasion of exotic and other species of plants (and especially animals) is often a serious problem for restoration projects, efforts to control phragmites in marshes like those in Barnegat Bay have generally been successful. Lastly, institutional constraints on restoration include legal, political, and economic considerations. By approaching restoration in the Barnegat Bay ecosystem as a partnership among the USACE, NJDEP, and other stakeholders, the projects selected in this report have a good chance of overcoming institutional constraints.

The constraints facing a restoration project include both those obstacles that can be minimized or eliminated and those that cannot be avoided, but the implications of which must be considered. The following is a list of potential solutions to some of the constraints faced when planning a wetlands restoration project in the Barnegat Bay ecosystem:

- X Achieve correct elevations for target plant species
- X Maintain proper drainage
- X Use appropriate transplanting material
- X Avoid areas with inappropriate sediments or water quality (e.g., too saline)
- X Properly time plantings
- X Apply sufficient maintenance (e.g., replanting, fertilization, wrack removal)
- X Address wave damage
- X Address ice rafting damage
- X Minimize boat and propeller damage
- X Minimize human disturbance
- X Address or minimize damage from grazing fish or geese
- X Provide sufficient monitoring and reporting

Although there is no standard approach to avoiding these pitfalls, there is a substantial literature on wetlands project design, describing general approaches and the conditions conducive to project success (Kentula 1999). Although many studies have been conducted in the last ten years, the U.S. Environmental Protection Agency (EPA) publication *Wetland Creation and Restoration: The Status of the Science* (Kusler and Kentula 1989) still stands as a good general reference. Elements that should be considered in any wetland project design are site-selection criteria, hydrologic analysis, water source and quantity, substrate augmentation and handling, buffer zone placement, and long-term management. The following more specific wetland construction principles and goals have been developed by Mitsch and Gosselink (1993):

- X Design the system for minimum maintenance.
- X Design the system that utilizes natural energies.
- X Design the system with the hydrologic landscape and climate.
- X Design the system to fulfill multiple goals.
- X Design the system as an ecotone.
- X Give the system time.
- X Design the system for function, not form.
- X Do not overengineer the system, mimic natural systems.

2.2.2 Abandoned Lagoons

The above discussion of wetlands restoration is largely applicable to abandoned lagoons as well. In essence, abandoned lagoons are more heavily modified sections of tidal wetlands that have resulted from historical development projects. Prior to the regulation of wetlands modification under Section 404 of the Clean Water Act and state laws, numerous wetlands in Barnegat Bay were dredged for marinas and housing projects. For various reasons, these developments were abandoned leaving lagoons and adjacent fill areas. Commonly, the natural hydrology of the wetland was changed and nuisance species such as phragmites have invaded. Today, remediation of these abandoned lagoons provides an opportunity to return the natural functioning and conditions to these wetlands.

Two projects specifically designed to restore lagoons have been reported from California: (1) Malibu Lagoon Peninsula was restored to create mudflat habitat for foraging birds and (2) Lower Zuma Creek and Lagoon in Santa Monica Bay was restored to enhance existing native habitats through removal of exotics, excavation, grading, and planting native species to increase habitat diversity (Information Center for the Environment 1999a,b).

2.2.3 Submerged Aquatic Vegetation

Much of what is discussed above for wetlands also applies to the restoration of SAV in the Barnegat Bay ecosystem. Like wetlands, SAV has suffered from the cumulative effects of development throughout the watershed. In particular, increased runoff from impervious surfaces has resulted in large amounts of sediment being delivered to the Bay, increasing the turbidity of the water. This turbidity reduces light penetration, which is needed by the SAV. Less light

penetration and other impacts have decreased the amount of SAV in Barnegat Bay from approximately 27,000 acres in 1979 to 10,000 acres today (a decrease of 63%). In addition, the distribution of SAV has changed; virtually no SAV currently exist along the western edge of the Bay or in its southern third.

In addition to the constraints discussed above for wetlands, the following additional factors pertain to implementation of successful restoration of SAV:

- X Address difficulty in replacing climax SAV species
- X Address inability of some restored SAV sites to attract animal communities of predisturbance sites
- X Compensate for the generally low proportion of SAV plantings that succeed (possibility of major transplant failure)
- X Compensate for having no standard planting patterns with guaranteed success
- X Minimize the clouding of water by animal or human activity
- X Address unpredictable severe weather
- X Avoid or compensate in areas with SAV wasting disease

SAV restoration success is more uncertain than success in tidal wetlands. The effects of depth, sediment type, and wave action are not entirely predictable and while SAV has been successfully restored in other areas, no examples of success exist in Barnegat Bay. Current research is focusing on the proper planting time given the different seasons for planting north and south of Barnegat Bay (Paul Bologna, Rutgers University, personal communication). A recent example of SAV restoration of fish habitat is the SAV planting in the Lower Chesapeake Bay conducted by the National Aquarium in Baltimore and Langley Air Force Base (Coastal America 1998a,b). This project involved restoring a 2-acre eelgrass bed followed by seahorse reintroduction. It was a part of a broad partnership to stimulate interest in restoration of seagrass habitats. The eelgrass will provide essential fish habitat for summer flounder, juvenile red drum, black sea bass, cobia, and spawning area for blue crabs. SAV planting is also an important part of island restoration projects at Poplar Island, MD and Munyon Island, FL (Coastal America 1999).

2.2.4 Islands for Bird Habitat

Barnegat Bay has historically contained many islands that provide critical nesting habitat for birds (both sandy habitat for terns and woody habitat for herons). In addition, there are a number of islands that have been created through the historical disposal of dredged material. These islands are generally covered with phragmites and are of low habitat value for nesting birds. Such created islands provide an important opportunity for the removal of phragmites and restoration of native vegetation and enhancement of bird populations.

Restoration of islands in Barnegat Bay can be a relatively simple project involving three components: (1) removal of existing invasive phragmites, (2) replanting with desirable vegetation or maintenance of sandy habitat, and (3) exclusion of nest predators (such as foxes) and human disturbance. An example of island restoration for bird habitat is Poplar Island in the

upper middle Chesapeake Bay, 34 miles southeast of Baltimore, MD. The U.S. Fish and Wildlife Service (USFWS), USACE, Baltimore District, Maryland Port Administration, Maryland Department of Transportation, and others are partners in this effort. Poplar Island has eroded since the 1800s and split into four parts, reducing its size from 1,100 acres to 5 acres. The island and its surrounding habitat support many bird species (as well as diamondback terrapins and river otters) and is preferentially used by migratory birds as a nesting area. The project is using approximately 38 million cubic yards of uncontaminated dredged material from Baltimore Harbor to restore the 1847 configuration of the islands. It includes restoration of 555 acres each of intertidal wetland and upland habitat. Ponds and channels will be created to increase habitat diversity (USFWS undated).

2.2.5 Fish Passage

Many anadromous (e.g., alewife and blueback herring) and catadromous (e.g., American eel) fish spawning runs located throughout the mid-Atlantic states (including New Jersey) have become impassable as dams were constructed (USFWS 1999). Returning anadromous and catadromous fish to their historic ranges is a national, regional, and local goal.

The opportunities for restoring fish passages in the Barnegat Bay ecosystem include (1) removing, breaching, or providing fish ladders at the dozen or so major dams in the watershed and (2) removing or breaching small dams and blockages associated with retired cranberry bogs or road culverts.

Restoration potential was evaluated at Lake Pohatcong and Manahawkin Lake by investigating fisheries resources at these sites during the spring and summer of 1999 (Versar 1999, USACE 2000). These studies indicated that there is ample potential river herring habitat above both dams and that water quality is adequate. There are possible limitations in food sources, particularly at Manahawkin Lake, owing to the naturally oligotrophic and low pH drainage (Donald Byrne, NJDEP, personal communication). However, the 1999 studies were conducted during historically low lake inflows and further studies are needed to estimate future food availability.

2.2.6 Dredged Holes

Numerous deep holes, up to 36 feet deep, exist in Barnegat Bay as a result of historic dredging and sediment removal for land and beach development. Many of these holes suffer low dissolved oxygen conditions and a loss of or reduction in resident biota. One option for the restoration of these areas as Bay bottom habitat is to obtain clean fill material from maintenance channel dredging or elsewhere and reduce the depth of the hole.

Ongoing studies of two dredged holes in Barnegat Bay indicate that both benthic invertebrate and fish communities can benefit from restoration of deep holes to shallower conditions. Specifically, the abundance and diversity of benthic macroinvertebrates decreases

with the depth of the hole, while the abundance of summer fish is highest at intermediate depths. No fish were found in the holes during the winter.

In one of the few documented efforts to fill dredged holes, 110,000 cubic yards of dredged sediments from the Intracoastal Waterway will be placed into an anoxic hole north of Munyon Island in Palm Beach County, FL. The goal of this project is to restore approximately nine acres of submerged aquatic habitat.

3. SITE SELECTION METHODOLOGY

The goal of this restoration site selection approach is to identify the best opportunities for ecosystem restoration through USACE/NJDEP projects in the Barnegat Bay estuary area. Identifying feasible, much less the best, restoration opportunities from such a large and diverse area is challenging. Nonetheless, recent improvements in watershed analysis have shown that an approach that combines both map overlays and field investigation can be comprehensive, timely, and cost effective. Comprehensive and cost-effective map overlays are now possible through the use of new and better GIS technologies and data.

In 1999, Versar developed and applied such a restoration site selection methodology for the USACE, Baltimore District, in Pennsylvania's rapidly developing Buffalo Creek watershed (Southerland et al. 1999). This procedure has become the model for other restoration projects in the Baltimore District and is being expanded with additional research funded by the Waterways Experiment Station for application nationwide. This restoration site selection methodology has four major components: (1) review of the environmental history and definition of attainable restoration goals for the watershed, (2) comprehensive screening of the entire study area using remotely sensed land features through GIS-based map overlays, (3) field investigation of candidate sites using data sheets customized by ecosystem types, and (4) rigorous evaluation of each site=s restoration potential using ecosystem-specific narrative and quantitative criteria.

3.1 STEPS IN THE SITE SELECTION METHODOLOGY

Versar has modified this successful methodology for application in the Barnegat Bay ecosystem. While it focuses on the estuarine environment, the methodology remains comprehensive (using GIS and other map information for complete or nearly complete coverage of the area), fairly detailed (involving field evaluation of sites), and practical (based on a multi-step screening process that uses only the minimum effort needed at each step). The multi-step screening process uses available data and ecologically relevant criteria for assigning values to areas and sites. Because the goal is to identify restoration opportunities, separate criteria are applied to each discrete ecosystem type/restoration opportunity. These criteria address both the degree of degradation and the potential for restoration benefit. The Barnegat Bay Ecosystem Restoration Site Selection methodology includes the following 12 steps:

1. Coordinate closely with the USACE, natural resource agencies, other interested parties, and the public.
2. Identify USACE restoration goals for Barnegat Bay and classify ecosystem types/restoration opportunities.
3. Review and assemble available spatial data from the parallel GIS data set task.
4. Conduct a field visit to verify ecosystem type problems and characteristics.
5. Develop criteria for identifying candidate sites of each type.
6. Assemble information on sites recommended by resource agents and the public.
7. Screen GIS/map data for candidate sites using criteria for each type.
8. Develop protocols for field investigation and validate with the USACE.

9. Conduct a field investigation.
10. Assemble and review field data.
11. Develop criteria for evaluating/scoring candidate sites.
12. Score and evaluate candidate sites using GIS and field data for those with the highest restoration potential.

Step 1. Coordinate closely with the USACE, natural resource agencies, other interested parties, and the public

A critical component of this project is the coordination between Versar, the USACE, natural resource agencies, other interested parties, and the public. This ensures that the diverse information available from multiple sources is used and that the best expert knowledge is acquired. It also provides for the essential involvement of and input from stakeholder groups and interested citizens. The coordination step began at project initiation, but continued throughout the period of performance. Coordination activities included the following:

- X Attend workshops, produce minutes, and obtain approvals from the USACE at critical steps in the project.
- X Review previous studies (relevant historical information, scientific literature, and expert opinion) and results from the BBEP and other initiatives.
- X Hold two public workshop at local libraries to introduce and present the evaluation process of the Barnegat Bay Ecosystem Restoration Site Selection.
- X Attend two meetings of the BBEP Management Committee to present and review the Barnegat Bay Ecosystem Restoration Site Selection.
- X Solicit opinions from resource agents and the public on the classification of ecosystem types/restoration opportunities, criteria for GIS/map screening, protocols for field investigation, and final candidate site evaluation/selection, as appropriate.

Note that recommendations from resource agents and the public made during this coordination were incorporated into the site selection process as described in Step 6.

Step 2. Identify USACE restoration goals for Barnegat Bay and classify ecosystem types/restoration opportunities

As described above, the USACE reconnaissance report states that the goal of this project is to identify and obtain specific information on the geographic locations of high-priority restoration sites. To refine the general goal of identifying priority candidate sites for specific USACE/NJDEP projects, the following more specific objectives were applied to selecting sites:

- X Sites with substantial problems (i.e., those that would produce the greatest benefits if restored)
- X Sites most conducive to restoration (i.e., those most likely to be successfully restored)
- X sites with fish and wildlife habitat degradation (i.e., those where natural resources would benefit from restoration that would be sustainable over time)

- X Sites whose restoration would benefit a large geographic region (i.e., those whose ecological linkages would most benefit ecosystem restoration)
- X Sites within the Federal interest
- X Sites within the interest of the non-Federal sponsor (NJDEP)

All of these objectives were incorporated (based on their relative importance) into the criteria ultimately used in selecting sites. Most importantly, we recognized that the different ecosystem types in Barnegat Bay present different environmental problems and therefore different restoration opportunities. For this reason, the following six ecosystem types were defined for separate consideration and final evaluation as priority restoration sites:

- X Tidal and nontidal wetland (both freshwater wetlands and salt marsh) restoration
- X Restoration of abandoned lagoons
- X SAV restoration
- X Restoration of islands for waterbird habitat
- X Restoration of fishery habitat through stream passage
- X Restoration of dredged holes for fish and invertebrate habitat

Step 3. Review and assemble available spatial data from the parallel GIS data set task

A GIS data review previously completed for USACE identified many spatial data layers, including both GIS and non-digital map information, that could be used for systematic site selection on a watershed basis. A second GIS data development task was then conducted to assemble the appropriate data layers for use in the site selection and other aspects of the feasibility study.

For the site selection, certain data layers were immediately available or were subsequently provided by the USACE. Other important layers were only available from Rutgers University and were acquired at a later date. To meet the time constraints on this project, the GIS data development was conducted on a rolling basis as data layers became available. In-house and USACE data layers were reviewed for the initial field site selection. The Rutgers GIS layers were reviewed and used as they were received. This GIS data development (incorporating both utility for site selection and later USACE use) evaluated all data sets for relevance to site selection and rated them as (1) required, (2) helps, or (3) does not contribute. These GIS data set the limits for which ecosystem types and restoration opportunities could be practically identified.

Based on the GIS data evaluation, we concluded we would use both GIS and non-digital maps in a map overlay process to identify the coincidence of appropriate features. We used maps of habitat types of concern (combinations of data layers that best predict habitat presence) as the primary support for the GIS screening step. In many cases, aerial photography was the best source for site characterization; elsewhere, we used it to validate other GIS data, refine criteria for site screening, and positively locate the site. Where available, historical data was used to identify environmental trends and habitat declines that might be addressed by restoration projects.

More details on the GIS data used in this project (including a table of data layers and their utility) is provided in Section 4, GIS Site Screening.

Step 4. Conduct field visit to verify ecosystem type problems and characteristics

Versar and USACE staff visited representative field sites on November 15 and 16, 1999 to become familiar with the kinds of environmental problems in the Barnegat Bay ecosystem and their potential restoration solutions. This step was critical to developing criteria for designating the ecosystem types and restoration opportunities to be evaluated. These field visits were coordinated with representatives from USFWS and Ocean County Parks and Recreation Department. They were conducted by Versar's project manager and lead field investigator. These field visits provided the Versar staff that would be involved in the GIS screening and site evaluation an opportunity relate different map features to in-field characteristics. Photographs and videotape recordings were made of selected sites for viewing by analysts not visiting the field.

The field visits focused on (1) retired cranberry bogs, (2) dredged material islands (both as uplands for herons and scarified beaches for terns), (3) ditched marshes (e.g., mosquito ditches), and (4) abandoned lagoons. The specific results of the initial field visits and discussion of restoration opportunities with USFWS Edwin B. Forsythe National Wildlife Refuge and Ocean County Parks and Recreation Department staff are discussed in the kickoff meeting minutes in Appendix A.

Step 5. Develop criteria for identification of candidate sites of each type

A critical step in the screening process is the application of ecologically relevant and analytically practicable criteria for identifying candidate sites. Initial criteria were drawn from the site selection approach used in the Buffalo Creek watershed and developed in brainstorming sessions among Versar=s in-house estuarine ecologists, wetland scientists, and fisheries and wildlife biologists. They were then modified in coordination with USACE. As appropriate, these criteria were refined and new criteria added iteratively throughout the analytical phases of the project.

While GIS/map screening criteria should be as comprehensive as possible, they are limited to available data. A separate set of criteria were developed for each distinct ecosystem type/restoration opportunity. The specific criteria chosen varied depending on the ecological situation involved and the information available. Where possible, the criteria included parameters that can be incorporated into post-project monitoring to determine the effectiveness of the restoration effort.

Specific information on the criteria developed is presented in Section 4, GIS Site Screening.

Step 6. Assemble information on sites recommended by resource agents and the public

Although GIS site screening provides comprehensive coverage of the entire study area, it undoubtedly misses potential restoration opportunities because of limited data and the scale of the analysis. Therefore, it was critical that input from natural resource agencies, other interested parties, and the general public be used to identify additional candidate sites.

Input from the natural resource agencies was obtained during the initial site visit, the public workshops, the BBEP Management Committee meeting, and individual conversations throughout the project. Public comments from citizens and interested parties were received during the two public workshops in January and February. Details on the sites recommended by resource agents and the public is included in Section 5, Resource Agency and Public Outreach Site Recommendations. Minutes of the public workshops are provided in Appendix A.

Step 7. Screen GIS/map data for candidate sites using criteria for each type

In this step, Versar applied a map overlay process using GIS-based algorithms and manual methods to delineate areas that met the criteria defined for each ecosystem type/restoration opportunity. While in most cases the map overlays were done within the GIS, features not available digitally were overlain manually. The size of the sites and areas identified by the map overlay varied from about 5 to 300 acres. An essential step in this process was the development of practical naming conventions for the target sites identified.

This process is described in detail in Section 4, GIS Site Screening.

Step 8. Develop protocols for field investigation and validate with the USACE

Field investigations are an important phase of the site selection process; they confirm expected site characteristics (seen in the GIS) and provide detailed site-specific information needed to evaluate and prioritize candidate restoration sites. Protocols are needed to ensure that comprehensive and comparable information is gathered for each site. This was accomplished through the use of detailed field data sheets (customized for each ecosystem type) and visual records via photographs and videotape. Field protocols also include the designation of unique site identification numbers and accurate geographic locations obtained by geographic positioning systems (GPS). Data sheets were reviewed and approved by the USACE.

Accurate field investigations require that the appropriate disciplines be represented on the field team. Consistency requires that the same staff visit all sites or that the interpretation of field conditions be calibrated among different field teams. For this project, Steve Harriott, Versar=s wetlands ecologist, supervised the investigation of all field sites. Other Versar staff, USACE personnel, and Marlene Cole of Rutgers University also participated in some of the field investigations. USACE staff accompanied Mr. Harriott on field visits by both car and boat to review and approve field protocols.

Narrative comments were included on the field sheets and the field investigators noted any information that might be useful in the final evaluation of candidate restoration sites. All data measurements and analysis were consistent with the state of the practice and conformed to USACE guidelines as appropriate. The types of information collected during the field investigation varied with the ecosystem type being evaluated. Section 6, Investigation of Field Sites, describes the protocols used in more detail and shows example field data sheets for each ecosystem type.

Step 9. Conduct field investigation

After the protocols for the field investigation were developed and approved by the USACE, Versar visited 66 sites identified during the GIS screening or recommended by resource agents or the public. Field investigations were conducted for the ecosystem types were field data were needed to confirm and understand restoration options, i.e., all tidal and nontidal wetlands, abandoned lagoons, and islands for bird habitat. These field measurements were incorporated into the site evaluation. The parameters used to evaluate the SAV, fish passage, and dredged hole sites did not require field information and these ecosystem types were evaluated using solely GIS criteria.

Given the tight project schedule, the field visits began in November and ended in February. Because of the absence of SAV during the winter, no field investigation of this ecosystem type was conducted. Relevant criteria for identifying potential SAV restoration sites were applied using maps of historical and existing SAV distribution. Similarly, secondary information was used to identify blockages to fish passage (based on the National dam inventory) and dredged holes (based on USACE surveys). Fish passage opportunities related to abandoned cranberry bog structures were identified during field visits to wetlands sites.

Additional discussion on the field investigation is included in Section 6, Investigation of Field Sites.

Step 10. Assemble and review field data

Following completion of the field investigations, Versar analyzed the collected information to evaluate the candidate sites with respect to the ecosystem types and associated restoration opportunities initially identified. The parameters measured were assigned standardized values to facilitate comparison among sites. We determined that the appropriate level of precision for the evaluation would be achieved by assigning each parameter high, medium, or low values. These scores were based on problem extent, problem severity, and restoration potential. Versar also evaluated the relative benefits of different prioritization approaches, including (1) ecologically linked restoration, (2) remediation of the worst problems, and (3) good site enhancement or expansion.

The raw data sheets collected at the 66 field sites are provided as scanned images on a compact disc as Appendix B. All photographs of each field site were also electronically scanned and are included on a compact disc as Appendix C. Compilations of the field results and parameter scoring are discussed in Section 7, Evaluation of Candidate Restoration Sites.

Step 11. Develop criteria for evaluating/scoring candidate sites

As important as it was to develop appropriate criteria for screening candidate sites, developing objective criteria for accurately evaluating the potential for successful restoration at these sites is perhaps more critical. Therefore, Versar developed a combination of GIS and field information criteria to determine which sites are the best restoration opportunities. These criteria included parameters associated with potential site-specific benefits and potential area-wide benefits (i.e., those related to linked projects that may provide greater than additive benefits to the watershed or local ecosystem). Criteria reflecting the likelihood of successful restoration were also developed. The product of the likelihood of successful restoration and the total potential benefit (generally two-thirds site-specific and one-third area-wide) is the expected restoration benefit for each site. A economic feasibility score was also developed for each site; it represents one-third of the total site score. Some modifications to the criteria occurred iteratively as the analysis was done. While standard scoring ranges were used as much as possible, each ecosystem type was evaluated separately. As with the GIS/map screening criteria for target sites, Versar coordinated closely with the USACE in the designation of these criteria and their scoring thresholds.

We designated as "best bets" those sites where we were confident of substantial restoration benefit based on objective ecological factors. Sites receiving the highest total scores were designated as "best values." It should be noted that other sites receiving high restoration scores in this site selection process may be undertaken by interested parties at a later date.

A detailed discussion of the site evaluation process and criteria is provided in Section 7, Evaluation of Candidate Restoration Field Sites.

Step 12. Score and evaluate candidate sites using GIS and field data for those with the highest restoration potential

Using the criteria developed for evaluating/scoring candidate sites, Versar scored all sites, both those visited in the field (66) and those scored with secondary data (54). Versar analysts focused primarily on the criteria drawn from the primary GIS and field parameters, but also included ancillary data obtained during the field investigation (i.e., field data notes, field drawings, photographs, and VHS video recordings). Mr. Harriott (who investigated all sites in the field) assigned all scores in consultation with other field analysts and in-house experts. Independent validation of random sites was done through a review of photographs and videotape by neutral analysts.

Sites within each ecosystem type were scored separately and reported in individual tables. For each table, sites were listed in order of descending restoration potential, based on the product of site-specific and area-wide ecological benefits times likelihood of restoration success. The economic feasibility of each site was provided in a separate column. Designations in each table identified those sites determined to be best bets (sites where we are confident of substantial restoration success) and best values (cost-effective and logistically feasible best bets). The decision process for assigning priorities and making final recommendations is described in Section 7, Evaluation of Candidate Restoration Field Sites.

4. GIS SITE SCREENING

The GIS site screening phase is critical to the site selection process, because it provides the most comprehensive coverage of the study area feasible. Even though it is impossible to visit the entire study area, important land features are available as maps and GIS data, many obtained through remote sensing technologies (i.e., satellite and aircraft recordings). Map overlay, either digitally in a GIS or manually with hardcopy maps, is a powerful tool for identifying areas with characteristics amenable to restoration. The following sections describe the specific GIS/map layers and land feature criteria applied during this phase to accomplish GIS screening of candidate sites with restoration potential in the Barnegat Bay ecosystem.

4.1 GIS LAYERS USED TO APPLY CRITERIA

Based on the GIS data evaluation, we concluded we would use both GIS and non-digital maps in a map overlay process to identify the coincidence of appropriate features. Base layers (both GIS and hardcopy) of general land features (i.e., road networks, land use, topography, and bathymetry) were important for identifying development patterns and general land suitability. Because combinations of data layers that best predict habitat presence were a primary support for the GIS screening step, aerial photography (from digital GIS files) was an important map layer. Several other GIS layers were used to identify specific habitat types (e.g., wetlands) and habitat condition (e.g., disturbed wetlands). Some of these layers were direct interpretations of remote sensing imagery; others were synthesized data from other research efforts (e.g., gap analysis of areas deserving of protection by The Trust for Public Land (TPL)).

The following hardcopy maps were used in the GIS site screening:

- X New Jersey Atlas and Gazetteer (scale 1:77,000)
- X Ocean County Atlas (scale 1:25,000)
- X Vertical, low-altitude, black and white aerial photographs

The following seven GIS data layers (with sources noted in parentheses) were used to identify candidate restoration sites:

- X Layer #1 – United States Geological Survey (USGS) 7.5-minute topographical quadrangles
- X Layer #2 - Ocean County, NJ wetlands (Ocean County, Office of Planning)
- X Layer #3 - Disturbed wetlands (NJDEP, Land Use Regulation Program (LURP)
- X Layer #4 - Parks and public lands (NJDEP, LURP)
- X Layer #5 - Overwash areas (NJDEP, LURP)
- X Layer #6 - Island gap analysis (TPL)
- X Layer #7 - Bathymetry data (USGS)
- X Layer #8 - Historical SAV
- X Layer #9 - Current SAV

4.2 CRITERIA FOR IDENTIFYING POTENTIAL RESTORATION SITES

The following criteria were chosen to reflect high restoration potential in each of the ecosystem types:

- X Sites with simpler restoration solutions (e.g., phragmites removal is simpler and less costly than major site reconstruction)
- X Proximity of sites to existing natural areas, especially those with high ecological value, (e.g., parks and reserves)
- X Sites where remedies can be practically applied (e.g., tidal reestablishment)
- X Sites where restoration would provide additional functional benefits (e.g., protection of shorelines from erosion)
- X Areas where restoration of two or more problems could be addressed together (e.g., restoring SAV beds adjacent to a new salt marsh)
- X Sites where restoration would have the maximum benefit (e.g., most miles of fish spawning habitat opened with construction of fish passage structures)
- X Locations where habitats occurred historically
- X Habitat types that have experienced historic loss or have special values
- X Habitats with the greatest benefit to target species (e.g., black skimmer, little tern, piping plover, or herons, egrets, and other wading or colonial nesting birds)
- X Lands in public ownership or otherwise amenable to project implementation

4.3 GIS OVERLAY RESULTS FOR EACH ECOSYSTEM TYPE

The GIS/map layers identified above were selected to match (to the extent feasible) the restoration site criteria for each ecosystem type. Then each relevant layer was combined (using ecologically relevant rules) to identify sites or areas matching these criteria. For example, sites were selected that were closer than a designated distance to exiting parks or preserves (that likely increase the benefit of restoration) or farther than a different distance from disturbance (that might limit restoration success). In the case of SAV, only those areas with historical records of SAV and depths between one and two meters (and meeting other criteria) were selected. The size of the sites and areas identified by the map overlay varied from about 5 acres to about 300 acres.

The following sections list the criteria and describe how they were applied for each ecosystem type. Figures showing each individual map layer and the resultant map overlay (with identified areas or sites) are also provided.

4.3.1 Tidal and Nontidal Wetlands Sites

The GIS/Map screening criteria for tidal and nontidal wetlands were:

- X Proximity to marinas, lagoons, housing developments, roads, dredged material disposal sites, and other anthropogenic features as indicators of potentially

degraded conditions

- X Signs of major ecological disturbance, including extensive areas of phragmites, major ditches, dikes, dams, channelized waterways, wetlands with obvious large areas of fill, cranberry bogs, and extensive grid ditching or open marsh water management (for mosquito control)
- X Disturbed wetlands within 100 feet of nontidal wetlands
- X Disturbed wetlands within 100 feet of tidal wetlands (including freshwater and saltwater)
- X Disturbed wetlands within or touching areas of parks or public lands (e.g., Forsythe National Wildlife Refuge; Bass River State Forest).
- X Overwash areas that were within or touching any tidal wetland

We reviewed several hardcopy map sets to identify both tidal and nontidal wetlands areas with obvious restoration potential. These included areas adjacent to marinas, lagoons, housing developments, roads, dredged material disposal sites, and other anthropogenic features. Maps used included the New Jersey Atlas and Gazetteer (Delorme 1999; scale 1:77,000) and the Ocean County Atlas (Hagstrom 1998; scale 1:25,000). We then referred to low-altitude black and white vertical aerial photographs for each area identified on these maps. Prominent physical features such as roads, large streams, coastlines, and marinas were used to locate the sites on the photographic images. The targeted areas on the aerial photographs were visually inspected for signs of major ecological disturbance, including extensive areas of phragmites, major ditches, dikes, dams, channelized waterways, wetlands with obvious large areas of fill, cranberry bogs, and extensive grid ditching (for mosquito control). GIS map overlays were done for tidal and nontidal wetlands separately, because individual layers for these wetlands types were available digitally.

Tidal wetlands and abandoned lagoon sites. In the first step, we queried the GIS for all mapped disturbed wetlands from Layer #3 within 100 feet of all tidal wetlands (all tidal types, including freshwater and saltwater) as mapped in Layer #2. A total of 15 sites were identified. In the second step, we queried the GIS for all Layer #3 disturbed wetland polygons within or touching areas of parks or public lands from Layer #4 (e.g., Forsythe National Refuge; Bass River State Forest). A total of seven sites were identified using this process (it should be noted that five of these sites coincided with the sites selected in step one). In the final step in this analysis, we queried the GIS for all mapped overwash areas in Layer #5 that were within or touching any tidal wetland. Two sites were identified in step three. Layer #1 was then added to the map to provide points of reference, including roads, streams, coastline, and other major features.

Nontidal Wetlands. The first step queried the GIS for all mapped disturbed wetlands from Layer #3 within 100 feet of all nontidal wetlands (all mapped nontidal types) as mapped in Layer #2. Layer #1 was then added to the map to provide points of reference, including roads, streams, coastline, and other major features. A total of nine sites were identified using this process.

Figure 4-1 illustrates the GIS layers used in this map overlay analysis; it shows the coincidence of these layers using relevant criteria and displays the 52 tidal and nontidal wetlands sites identified.

4.3.2 Abandoned Lagoon Sites

Abandoned lagoon sites were identified at the same time, and using the same criteria, as the tidal and nontidal wetlands. Such sites exhibit a severe form of wetlands disturbance and restoration goals are similar to those for wetlands. In general, abandoned lagoons were visible on hardcopy and GIS maps (especially aerial photographs) and were differentiated from surrounding wetlands on a case-by-case basis. A total of six abandoned lagoon sites were identified.

The GIS layers illustrated in Figure 4-1 were also used in the map overlay analysis for abandoned lagoons. Figure 4-2 shows the coincidence of these layers using relevant criteria and displays the six abandoned lagoon sites identified.

4.3.3 Submerged Aquatic Vegetation Sites

The GIS screening criteria were critical to identifying good SAV restoration opportunities. Because the field investigations were conducted during the winter, no assessment of the field condition of existing or potential SAV beds was possible. Nonetheless, SAV scientists agree that the following criteria are appropriate for identifying sites for SAV restoration:

- X Historic SAV presence
- X Water depth between one and two meters
- X Size of area greater than 10 acres
- X Distance of area from any navigation channel greater than 100 meters
- X Adequate light penetration (excluding the western half of the Bay)
- X Adjacent to existing SAV areas

Figure 4-3 illustrates the bathymetry layer used in the SAV analysis. Figure 4-4 shows the coincidence of all layers using relevant criteria and displays the 18 SAV sites identified. Note that the southern most site is outside the range of existing SAV, but was included because of ongoing SAV restoration efforts in that area.

4.3.4 Islands for Bird Habitat Sites

Barnegat Bay has historically contained many islands that provide critical nesting habitat for birds (both sandy habitat for terns and woody habitat for herons). In addition, there are a number of islands that have been created through the historical disposal of dredged material. These islands are generally covered with phragmites and of low habitat value for nesting birds.

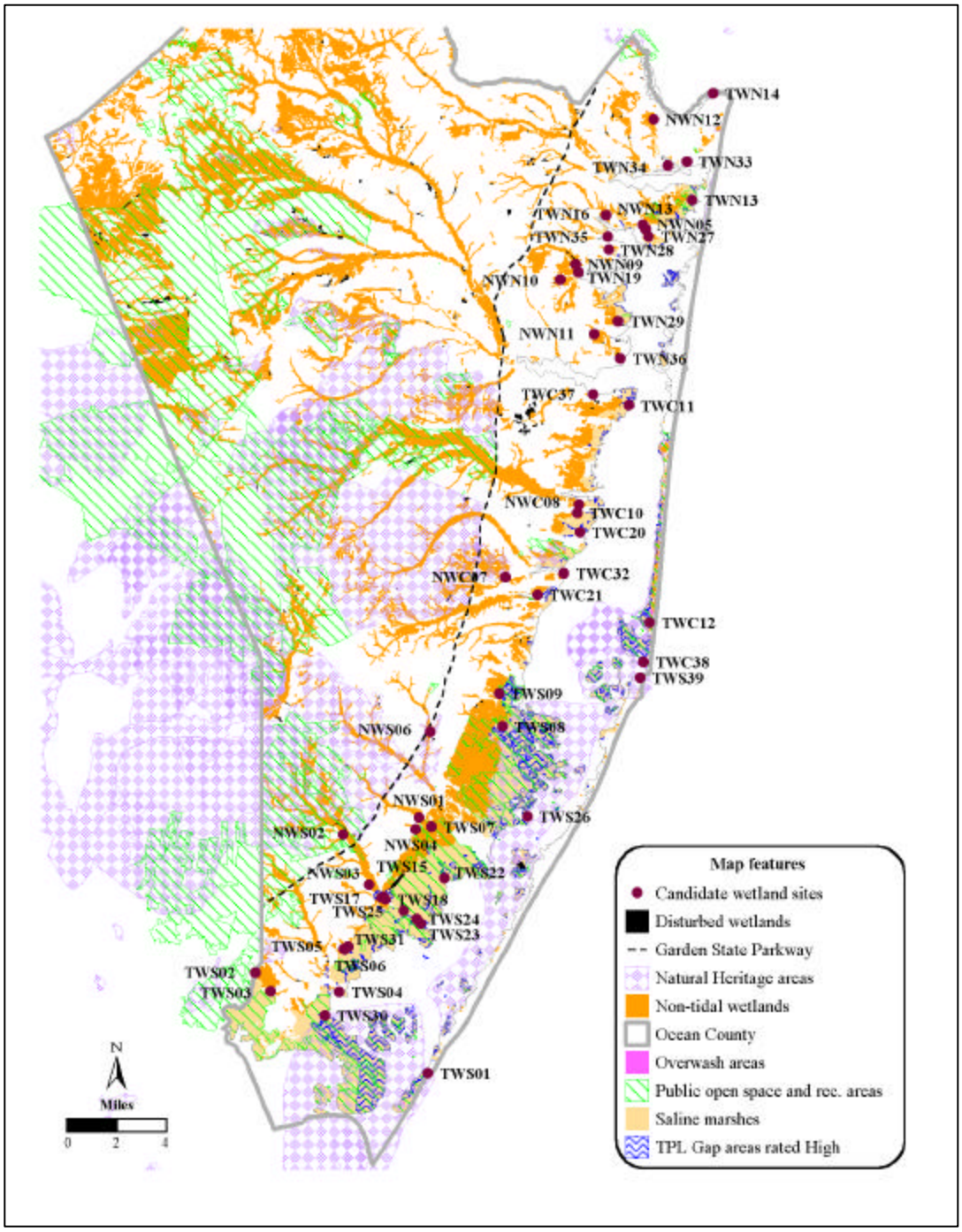


Figure 4-1. Candidate tidal and nontidal wetlands restoration sites (52 total) within the Barnegat Bay ecosystem. GIS data layers used to select the candidate sites are also shown. See Section 4.3.1 for a description of GIS map overlay selection rules.

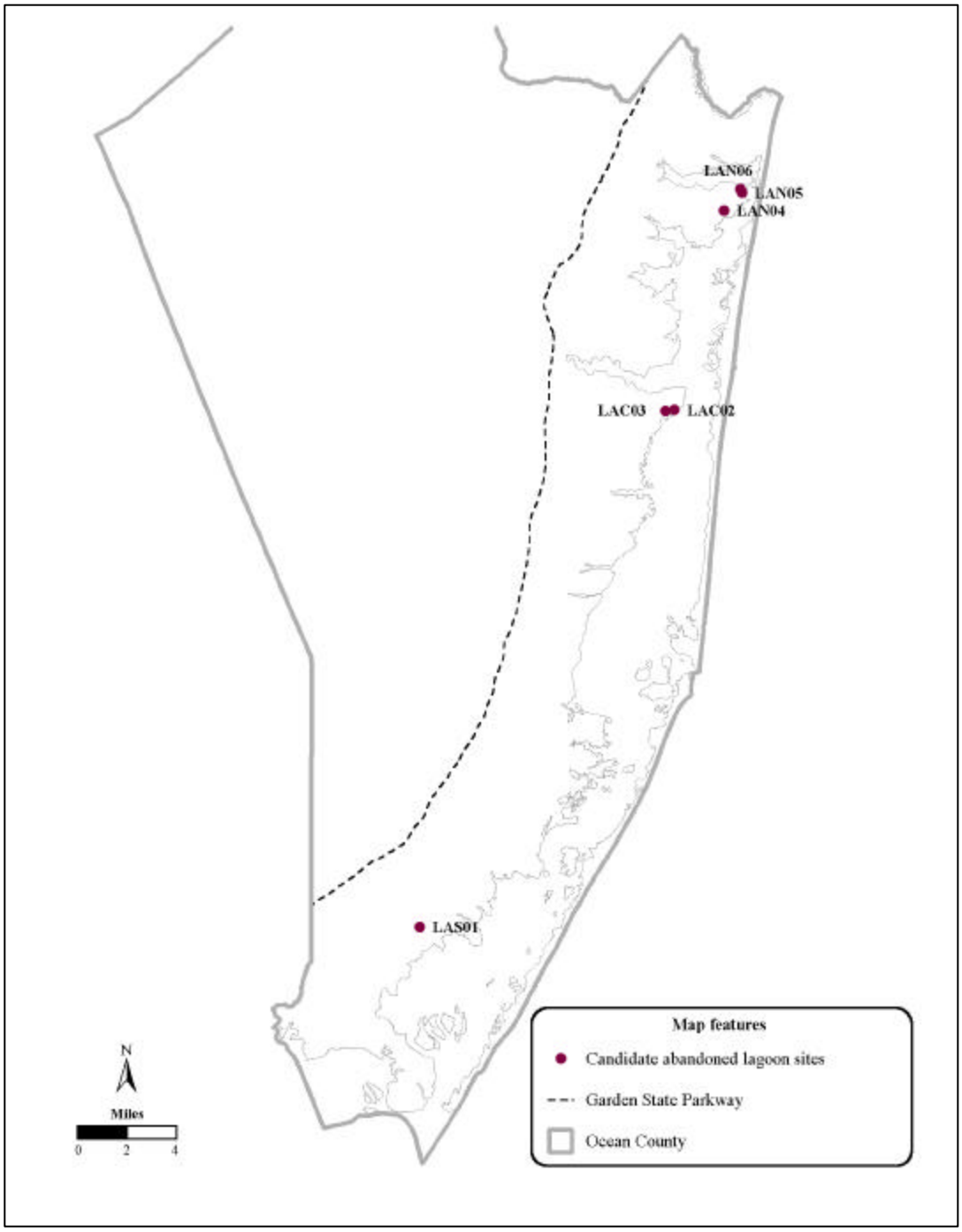


Figure 4-2. Candidate abandoned lagoon sites (6 total) within the Barnegat Bay ecosystem. GIS data layers used to select candidate sites are the same as those used to select wetland sites (Fig. 4-1). See Section 4.3.2 for a description of GIS map overlay selection rules.

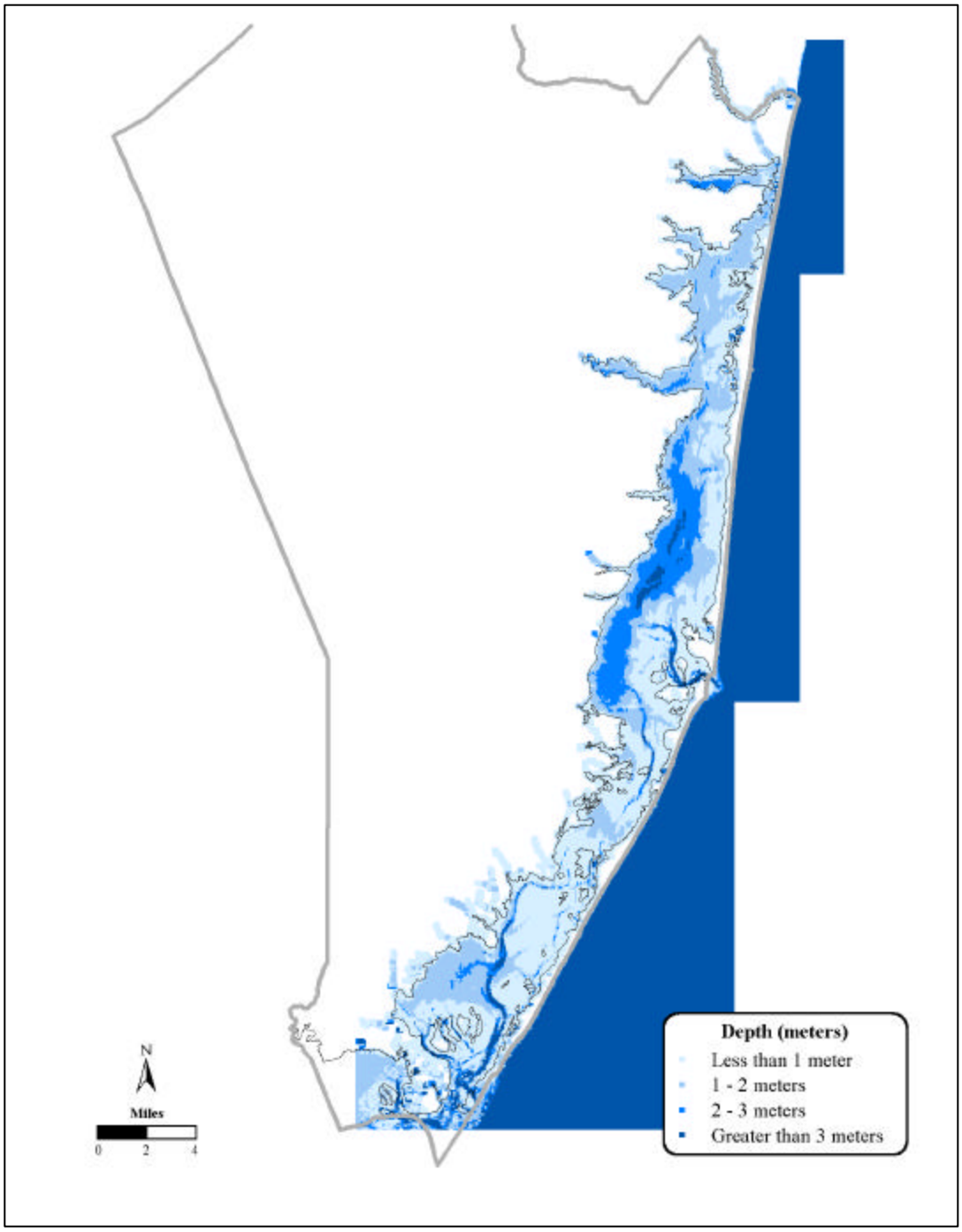


Figure 4-3. Bathymetry GIS data layer used in selecting candidate submerged aquatic vegetation (SAV) sites within the Barnegat Bay ecosystem

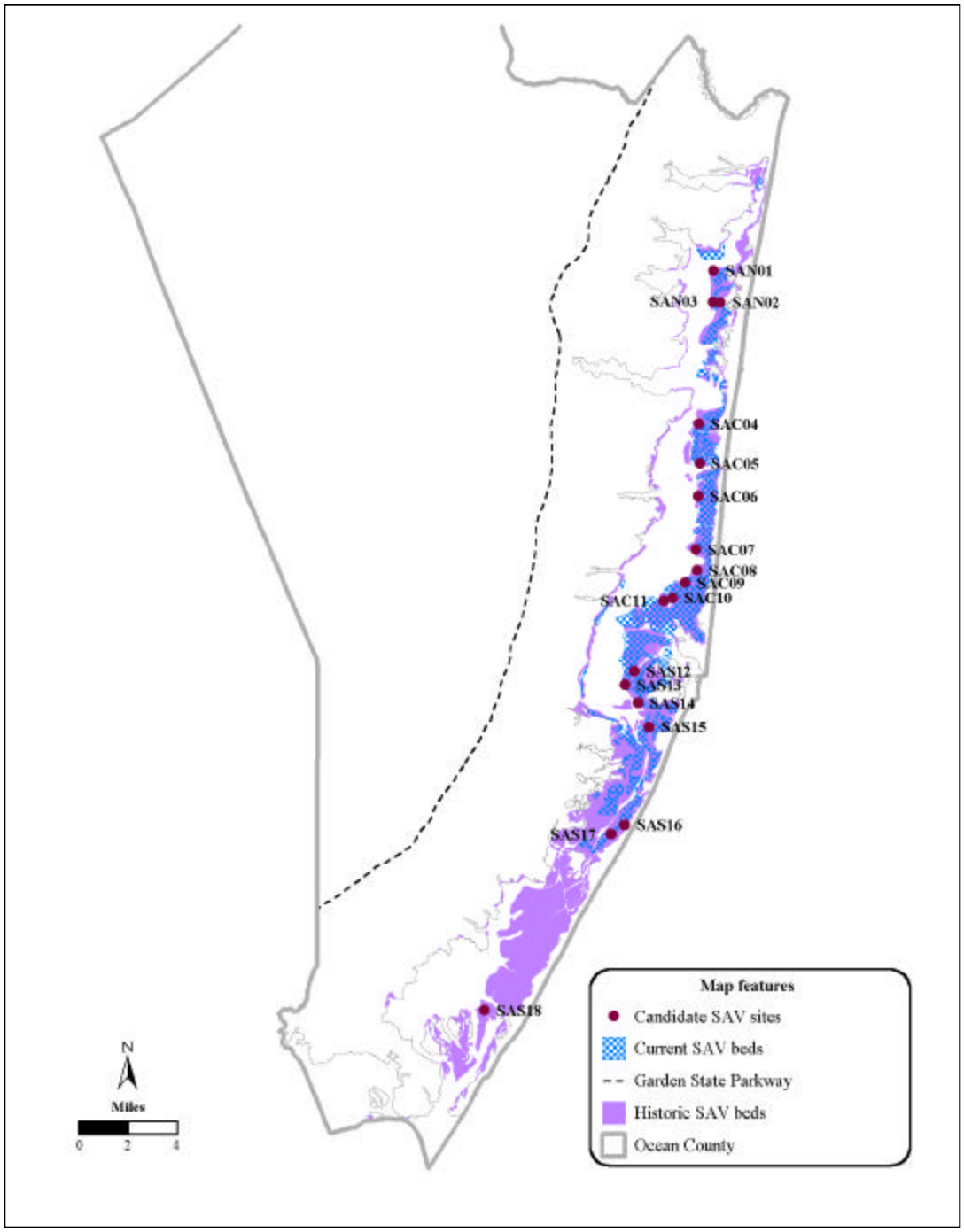


Figure 4-4. Candidate submerged aquatic vegetation (SAV) sites (18 total) within the Barnegat Bay ecosystem. GIS data layers used to select the candidate sites are also shown. See Section 4.3.3 for a description of GIS map overlay selection rules.

Such islands were addressed in the GIS screening using most of the same maps used for wetlands and abandoned lagoons. The GIS/Map screening criteria for islands for bird habitat were:

- X Existing islands with extensive areas of common reed (and potential for conversion to native woody vegetation or sandy areas)
- X Islands that were assigned Alow priority@ for purchase by the TPL gap analysis and were either
  - S At least 0.25 mile from the mainland or Long Beach Island (to decrease the likelihood of disturbance or predator invasion)
  - S Within 500 feet of mapped parks or public lands

Low-altitude black and white vertical aerial photographs were reviewed for visible islands. Prominent physical features such as roads, large streams, coastlines, and marinas were used to locate the sites on the photographic images. We then inspected the island sites for extensive areas of phragmites, woody vegetation, or sandy areas.

To better characterize these islands, we used maps of the gap analyses done to support the TPL Century Plan. Using the GIS, Layer #6 was created by manually entering data from hard copy TPL maps. Islands that were assigned (by TPL) "low/lowest priority" for purchase (i.e., relatively low current ecological value or use by nesting birds) were selected. We then queried this created layer to determine all low/lowest islands that were also at least 0.25 mile from the mainland or Long Beach Island. Layer #4 and Layer #6 were then combined to identify all low/lowest islands that were within 500 feet from all mapped parks and public lands. Next we combined Layers #6 and #7 to select all low/lowest islands that were adjacent to deep areas (i.e., the intercostal waterway and other navigation channels). A total of 13 island sites met one or more of these criteria.

Figure 4-5 illustrates the coincidence of these layers using relevant criteria and displays the nine island sites identified.

4.3.5 Fish Passage Sites

The USACE is currently investigating the potential benefits of restoring anadromous and catadromous fish passage at the dams at Manahawkin Lake and Lake Pohatcong (USACE 2000). A number of fish blockages related to cranberry bogs were identified in the tidal and nontidal wetlands analysis described above and are included as benefits for those wetlands projects. Other dams exist in the study area, however, and this fish passage analysis addresses the restoration potential at dams appearing on the National Inventory of Dams for the State of New Jersey (as contained in the database at http://crunch.tec.army.mil/nid/webpages/nid.html).

According to this database, there are 11 dams within the study area (i.e., the area at or downstream of the Garden State Parkway to Barnegat Bay). All were selected in the GIS screening. Criteria addressing potential habitat for fish above each dam are discussed in Section 7, Evaluation of Candidate Restoration Field Sites.

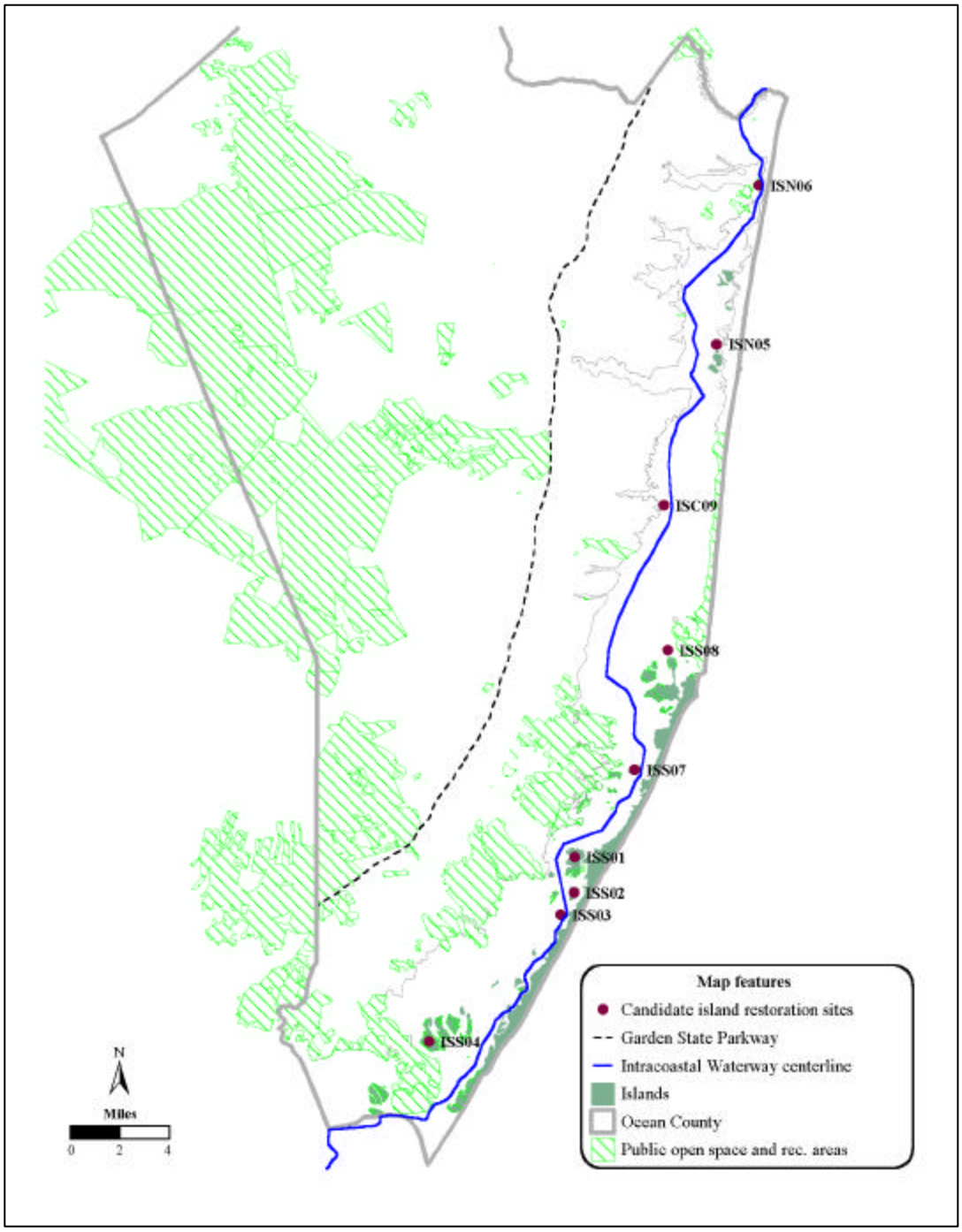


Figure 4-5. Candidate island restoration for bird habitat sites (9 total) within the Barnegat Bay ecosystem. GIS data layers used to select the candidate sites are also shown. See Section 4.3.4 for a description of GIS map overlay selection rules.

Figure 4-6 illustrates the GIS data layers used and displays the 11 fish passage sites identified.

4.3.6 Dredged hole sites

The USACE is currently investigating the potential benefits of partially filling two dredged holes identified as holes #5 and #6 by Murawski (1969) and located in Loveladies and Harvey Cedars, respectively. Murawski found a total of 29 dredged holes in the study area; recent USACE surveys discovered that 3 of these holes no longer exist and that 2 holes are very shallow. Other smaller holes certainly exist, but they have not been clearly identified on existing maps. Therefore, this dredged holes analysis addresses the restoration potential of the 24 holes identified and surveyed by USACE in winter 2000. All were selected in the GIS screening.

Figure 4-7 illustrates the location of the identified dredged hole sites.

Criteria addressing potential habitat for fish and invertebrates based on depth of each dredged hole are discussed in Section 7, Evaluation of Candidate Restoration Field Sites.

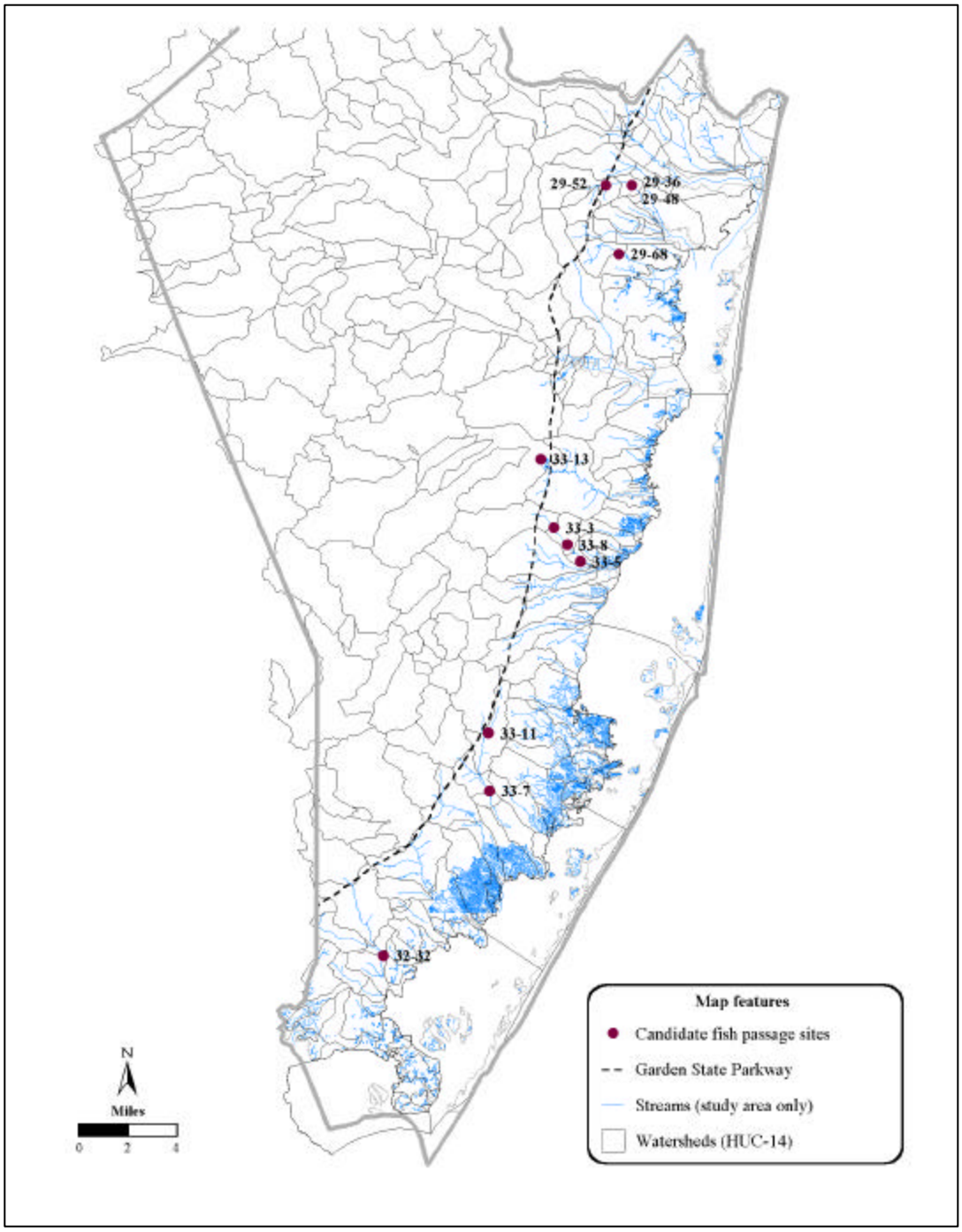


Figure 4-6. Candidate fish passage sites (11 total) within the Barnegat Bay ecosystem. GIS data layers used to select the candidate sites are also shown. See Section 4.3.5 for a description of GIS map overlay selection rules.

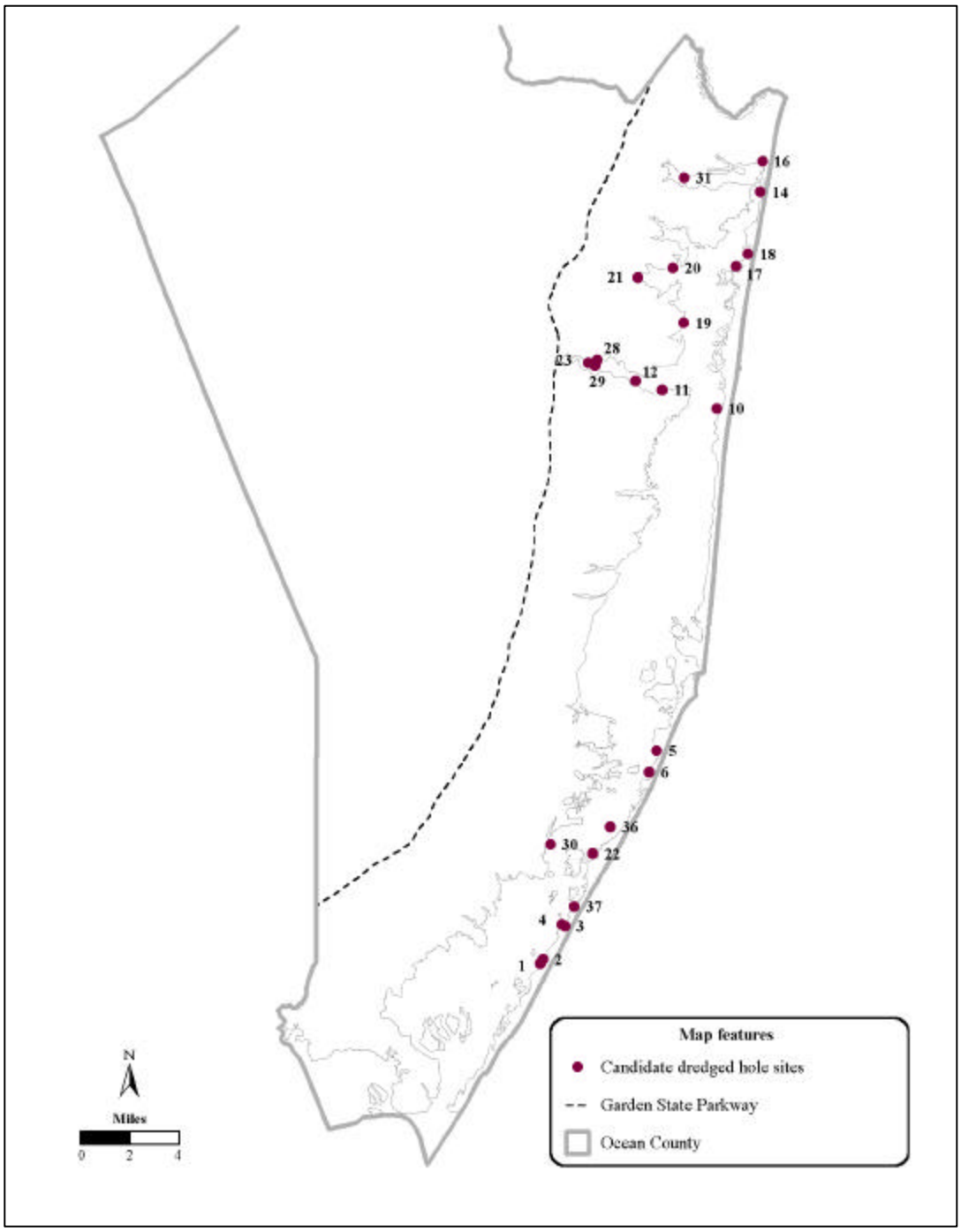


Figure 4-7. Candidate dredged hole sites (24 total) within the Barnegat Bay ecosystem. GIS data layers used to select the candidate sites are also shown. See Section 4.3.6 for a description of GIS map overlay selection rules.

5. RESOURCE AGENCY AND PUBLIC OUTREACH SITE RECOMMENDATIONS

The USACE conducted extensive outreach to local resource agencies and the public to identify issues of concern and solicit recommendations for restoration sites. Potentially interested parties were contacted with meeting announcements, press releases, and telephone calls. Copies of the announcements and press releases are included (with lists of mailing recipients and press notified) in Appendix A.

Input from resource agencies was obtained during the initial site visit, public workshops, BBEP Management Committee meetings, and individual conversations throughout the project. Public comments from citizens and interested parties were received during the two public workshops in January and February. Minutes of the public workshops and Committee meetings (including lists of attendees) are provided in Appendix A. Several newspaper articles discussing the results of the workshops are also included in Appendix A.

The following is a summary of restoration sites recommended by resource agents and the public.

5.1 NATURAL RESOURCE AGENCY RECOMMENDATIONS

A number of potential restoration sites were recommended by the staff of the USFWS, NJDEP, and Ocean County. The types of sites included tidal and nontidal wetlands, abandoned cranberry bogs, abandoned lagoons, and islands. Some of the sites were already selected (in whole or in part) in the GIS screening analyses described above; others were entirely new. The following sites were recommended by outside sources listed:

- X USFWS**.** Cedar Bonnet Island (ISS01); Cedar Run abandoned cranberry bog (NWS01); Collins Road/FWS (TWS08); and Cedar Run dredged material disposal area (TWS22).
- X NJDEP**.** Stafford Forge Wildlife Management Area (NWS02).
- X Ocean County**.** Cattus Island County Park (TWN29; parcel within southern part of park), four abandoned lagoon sites (LAC02 AND LAC03, Berkeley Township; LAN04, Lacey Township; LASO1, Stafford Township).

5.2 RECOMMENDATIONS AT PUBLIC WORKSHOPS

A workshop was held on January 24, 2000 to provide the general public with a brief introduction to the site selection project and solicit input on recommended restoration sites. A total of 37 individuals attended, including state and local agency representatives, special interest groups, and private citizens. During discussions at three map stations staffed by project personnel, participants recommended 25 potential project sites. The locations and a brief description of each are included in Table 5-1.

Table 5-1. Summary comments from January 24, 2000 public workshop and the February 15, 2000 Barnaget Bay Estuary Program Management meeting on Barnegat Bay Ecosystem Restoration Site Selection

Suggestion Numbers (Site Number)	Name and Address	Phone Number/Email	Location of and Recommendations for Suggested Project (Versar Comment)
100 (TWC32)	Horrace Giambattista 1204 Gemini Court Forked River, NJ 08731	(609) 971-7184	Forked River back lagoons. Main channel is 3.5 to 6 feet in depth. The lagoons can be as deep as 16 feet. Flow is restricted in this area, endangering eel pots that are set in the main channel. Recommends dredging the channel. (Visited site on 2/17/00.)
101 & 104A	Russ Palumbo Lacey Township 818 W. Lacey Road Forked River NJ 08731	(609) 693-1100 ext. 8	Lagoon channels associated with Laurel Harbor are causing a reduction in flow, with potential effects to wildlife. Recommends dredging the channel entrances. (Ecological benefit of recommendation is uncertain. Did not visit site.)
102	Henry Wolff 145 Westbrook Drive Toms River, NJ 08757	(732) 349-4931 or (732) 244-1484	Shoaling of Davenport Branch of the Toms River causes diversion of stream, creating stagnant pools and large islands. The condition is conducive for mosquito breeding and impedes stream flow. (Site is well outside study area. Did not visit the site.)
103 & 104 (TWC38)	Paul "Pete" McLain 10 Cedar Drive Toms River, NJ 08753	(832) 349-6418	Sedge Island Wildlife Management Area (WMA). Recommends reopening (dredging) Mud Channel and develop colonial nesting bird habitat adjacent to Barnegat Inlet. Place fill from mud channel dredging on the Sedge Island marsh area to the immediate north of the inlet (where USACE is installing geotubes for stabilization of the area) to establish colonial nesting bird habitat. (Visited site on 2/28/00.)

Table 5-1. Continued

Suggestion Numbers (Site Number)	Name and Address	Phone Number/Email	Location of and Recommendations for Suggested Project (Versar Comment)
105 & 106 (TWS39) (TWC38) (ISC08)	William Vibbert NJDEP, Division of Parks and Forestry P.O. Box 37 Seaside Park, NJ 08752	IBSP@eclipse.net	Three potential projects adjacent to Barnegat Inlet: (1) South of inlet, Island Beach State Park south jetty; (2) island inside inlet; and (3) geotube area north of inlet (Little Bay breach). Recommends removing beach grass and phragmites to enhance beach-nesting bird habitat; also recommends adding fencing and appropriate interpretive signs. These sites have a documented history of breeding by nesting birds, including piping plovers, least terns, black skimmers and oystercatchers. Sites should be regraded and the vegetation removed to improve the habitat for these birds. The NJ Beach Buggy Association is interested in collaborating in this effort (see suggestion 106). (Visited sites on 2/17/00 and 2/28/00.)
106 (TWS39)	Bob DeLeonard NJ Beach Buggy Assn. P.O. Box 511 Seaside Park, NJ 08752	(732) 793-8080 wildbob@monmouth.com	See suggestions 105 & 106, above. He is particularly interested in area to the south of the Barnegat Inlet (#106). Recommends eliminating beach grass and phragmites to create/improve habitat for beach-nesting birds (particularly piping plovers). Indicated that he could recruit volunteers to implement the project. (Visited sites on 2/17/00 and 2/28/00.)
107 (LAN05) (LAN06)	Martin Sarrett 543 Carroll Fox Road Brick, NJ 08724	(732) 295-7975	Area near Mantoloking Road. The AF@ cove is an abandoned lagoon (see map on suggestion card). (Visited sites on 2/28/00.)

Table 5-1. Continued

Suggestion Numbers (Site Number)	Name and Address	Phone Number/Email	Location of and Recommendations for Suggested Project (Versar Comment)
108	Anthony Dantoni 1236 Laurel Blvd. Lanoka Harbor, NJ 08734 Marie Hoefling 1234 Laurel Blvd. Lanoka Harbor, NJ 08734	(609) 242-0335	Same as suggestions 101 and 104A; recommends same action. (Ecological benefit of recommendation is uncertain. Did not visit the site.)
109 (TWN34)	Ruth L. Sarrett 543 Carroll Fox Road Brick, NJ 08724	(732) 295-7975	Crescent-shaped island in South Branch of Beaver Dam Creek, across from 543 and 547 Carroll Fox Road. Dredged material island has been eroding as have other nearby islands. This particular island has been breached in the middle. (Visited site on 2/18/00.)
110 (ISC08)	Jim White 18 Compass Road Waretown, NJ 08758	(609) 693-6320	Island with USACE designation 26A (see also suggestion 104). Indicated that he believes the runoff from this island is killing adjacent SAV. Asked whether we could get rid of the large population of herring gulls that currently use the island. (Visited site on 2/28/00.)
111 (NWS02)	Patrick Filardi 276 Manchester Avenue Lanoka Harbor, NJ 08734	(609) 693-2567	Westecunk Creek, Eagleswood. Recommends investigating the feasibility of constructing fish ladders (or removing blockages) at the Midway Spillway and the Stafford Forge WMA on Westecunk Creek. (Revisited sites on 2/18/00.)
112 (ISC09)	Paul Burrowes III 825 Bowsprit Pt. Lanoka Harbor, NJ 08734	(609) 971-7192	Island north of Cedar Point at the south side of Cedar Creek. The island has eroded noticeably in recent years. Recommends designing a project to stabilize the channel and restore the island. (Visited site on 2/28/00.)

Table 5-1. Continued

Suggestion Numbers (Site Number)	Name and Address	Phone Number/Email	Location of and Recommendations for Suggested Project (Versar Comment)
113 (TWN36)	Mrs. Patricia Terpanick 20 Mobile Avenue Woodbridge, NJ 07095	Not available (N/A)	Toms River, Bay Shore development. Recommends removing remnants of old marina, including dilapidated pilings dangerous docks, and garbage. (Visited site on 2/18/00.)
114 (TWS31)	Borough of Tuckerton (telephone call to T. Fowler of USACE on 28 January 2000)	N/A	Three lagoons on Thompsons Creek, near Tuckerton. Recommends dredging Thompsons Creek to improve flushing of the lagoons. There is concern that a heavy slug of pollutants is currently brought in during storm events. They feel dredging the creek would even out the input of pollutants into the lagoons. (Visited site on 2/17/00.)
201 (TWN35)	Joseph V. Tomasi 23 Bayway Brick, NJ 08724	(732) 864-9757 or (973) 256-9173	Kettle Creek channel, between Brick and Toms River. Channel has filled in with sand, making navigation difficult. Recommends dredging channel. (Visited site on 2/18/00.)
202 (TWN33)	Dawn and Eric Wagner 1632 Mayfair Ct. Point Pleasant, NJ 08742	(908) 892-0945 ericwag@att.com	Salt marsh off Beaver Dam Creek, Point Pleasant Borough between Bayhead Shores and Sunshine Harbor developments. Marsh is rapidly eroding owing to boat wakes and goose foraging. Recommends revegetation and erosion control in eroded marsh (note good map on back of suggestion card). (Visited site on 2/18/00.)

Table 5-1. Continued

Suggestion Numbers (Site Number)	Name and Address	Phone Number/Email	Location of and Recommendations for Suggested Project (Versar Comment)
301 (TWS38)	Bill Hammarstrom 11 Roberts Road Waretown, NJ 08758	(609) 693-4281	Sedge Islands - High Harbor Dike (see also suggestion 104). Recommends adding 4,700 ft. of geotube on north side; adding 1 mile of geotube on west side of dike; and dredging the northwest from lighthouse to main channel. (Visited site on 2/28/00.)
302 (TWC37)	Paul E. Butow, Jr. Councilman, Borough of Oceangate 151 E. Longport Ln. 100 Ocean Gate, NJ 08740	N/A	Jeffrey=s Creek, Ocean Gate Drive. He is concerned about erosion on the banks of stream, in a natural wildlife corridor. Fecal coliform count is high. Road is threatened with increased erosion; silt deposition is causing shallow bed. (Visited site on 2/18/00.)
303	Pat Johnson Tuckerton (dropped off type-written form)	(609) 494-5900 ext. 3035 or (609) 296-2162	Lake Pohatcong, Tuckerton Borough. Recommends dredging to create a Aswimmable lake@ and improve water quality emptying into the Bay. (Site visited as part of the feasibility study on fish passage opportunities at Lake Pohatcong.)
304 (SAC08)	Dr. Paul Bologna Rutgers University 132 Great Bay Blvd. Tuckerton, NJ 08087	(609) 296-5260 ext. 255 bologna@imcs.rutgers.edu	Little Egg Harbor and Sedge Islands. Recommends initiating SAV restoration efforts through experimental plots. Plots could be done within varying planting densities and techniques; the timing of planting is also an important factor (recommends planting in fall/winter). He also indicated that Shelter Island has the best SAV that he has seen and may be a good seed source. (Did not visit any SAV sites owing to absence of vegetation during winter field investigation.)

Table 5-1. Continued

Suggestion Numbers (Site Number)	Name and Address	Phone Number/Email	Location of and Recommendations for Suggested Project (Versar Comment)
305A&B	Robert R. Fiorile Environmental Design Group 582 Plaza Terrace East Brick, NJ 08732	(732) 477-3203 rrf@birdsall.com	Manasquan River near Glimmer Glass. Recommends two projects: (1) eradicate phragmites and plant with native species, (2) plant spartina to enhance existing mudflat. (These two sites are well outside the study area. Did not visit the site.)
306	Michael S. Sinnema Environmental Design Group 582 Plaza Terrace East Brick, NJ 08732	(732) 477-3203 ms@birdsall.com	Manahawkin Bay. Recommends restoring SAV near Route 72 in areas far from the Intercoastal Waterway. (Did not visit any SAV sites owing to absence of vegetation during winter field investigation.)
307	Mr. & Mrs. Spencer 1349 Laurel Blvd. Lanoka Harbor, NJ 08734	(609) 242-2820 roseannes@aol.com	Laurel Blvd. Areas with abandoned lagoons, erosion, wetland loss, dredged area (last spring), and development. Recommends considering cutting new channel to provide access and remove need to keep lagoons open. (Ecological benefit of recommendation is uncertain. Did not visit the site.)
308	Joe Rizzo N.J. Shellfisheries Assn. 845 S. Main Street Mayetta, NJ 08092	N/A	Dredged hole along bank of N. Oyster Creek at Forked River. Dead vegetation in hole producing a dead zone (see map/sketch on suggestion sheet). (Dredged hole sites were not visited as part of the field investigation owing to insufficient time for appropriate data collection.)
309	Joe Rizzo N.J. Shellfisheries Assn. 845 S. Main Street Mayetta, NJ 08092	N/A	Sunks [sic] behind bulkheads along Long Beach, north of bridge, near Surf City. (Dredged hole sites were not visited as part of the field investigation.)

Table 5-1. Continued

Suggestion Numbers (Site Number)	Name and Address	Phone Number/Email	Location of and Recommendations for Suggested Project (Versar Comment)
501	Angela Anderson American Littoral Society P.O. Box 1306 Tuckerton, NJ 08087	(609) 294-3111	Recommends control phragmites on old dredged materials disposal island (Ham Island) and promoting songbird habitat. (Did not visit site owing to access problems.)
502 (TWS30)	Angela Anderson American Littoral Society P.O. Box 1306 Tuckerton, NJ 08087	(609) 294-3111	Recommends removing phragmites from channel to Big Thorofare Creek. (Visited site on 2/17/00.)
None	Rudy Moni 540 Princess Ct. Toms River, NJ 08753	(732) 270-1830 moni_rudy @adelphia.net	No specific recommendations. Wants to get on mailing list.
None	John F. Boyle Forked River Mountain Coalition 801 Lakeside Drive North Forked River, NJ 08731	(609) 242-3042	Wants to be put on mailing list.
None	Ms. Jan Larson Rutgers Cooperative Extension 1623 Whitesville Rd. Toms River, NJ 08755	(732) 505-3671 larson @aesop.rutgers.edu	No recommendations.
None	Gary DeFranco 1009 Devon St. Forked River, NJ 08731	(609) 971-3362	Made a general suggestion that future dredging projects and disposal needs should be considered and planned prior to restoration of any sites.

On February 15, 2000, Versar and USACE met with the BBEP Management Committee and received the following recommendations from the 10 members (or cooperators) present:

- X Two project locations involving bird habitat and phragmites removal in Little Egg Harbor were suggested by Angela Anderson of the American Littoral Society.
- X Bob Dieterich of EPA Region 2 indicated that he supported the islands and wetlands restoration ideas.

Dave McKeon of Ocean County Planning and Ed Henry of USFWS left before the presentation, but were contacted the following day. Dave McKeon stated that no specific sites came out of his County Planning Board meeting; likewise, Ed Henry had no new sites to add.

Minutes from these meetings and additional materials on specific sites submitted after the meeting are provided in Appendix A. Locations of all visited sites recommended by the public (and occurring within the study area) are shown in Figure 5-1.

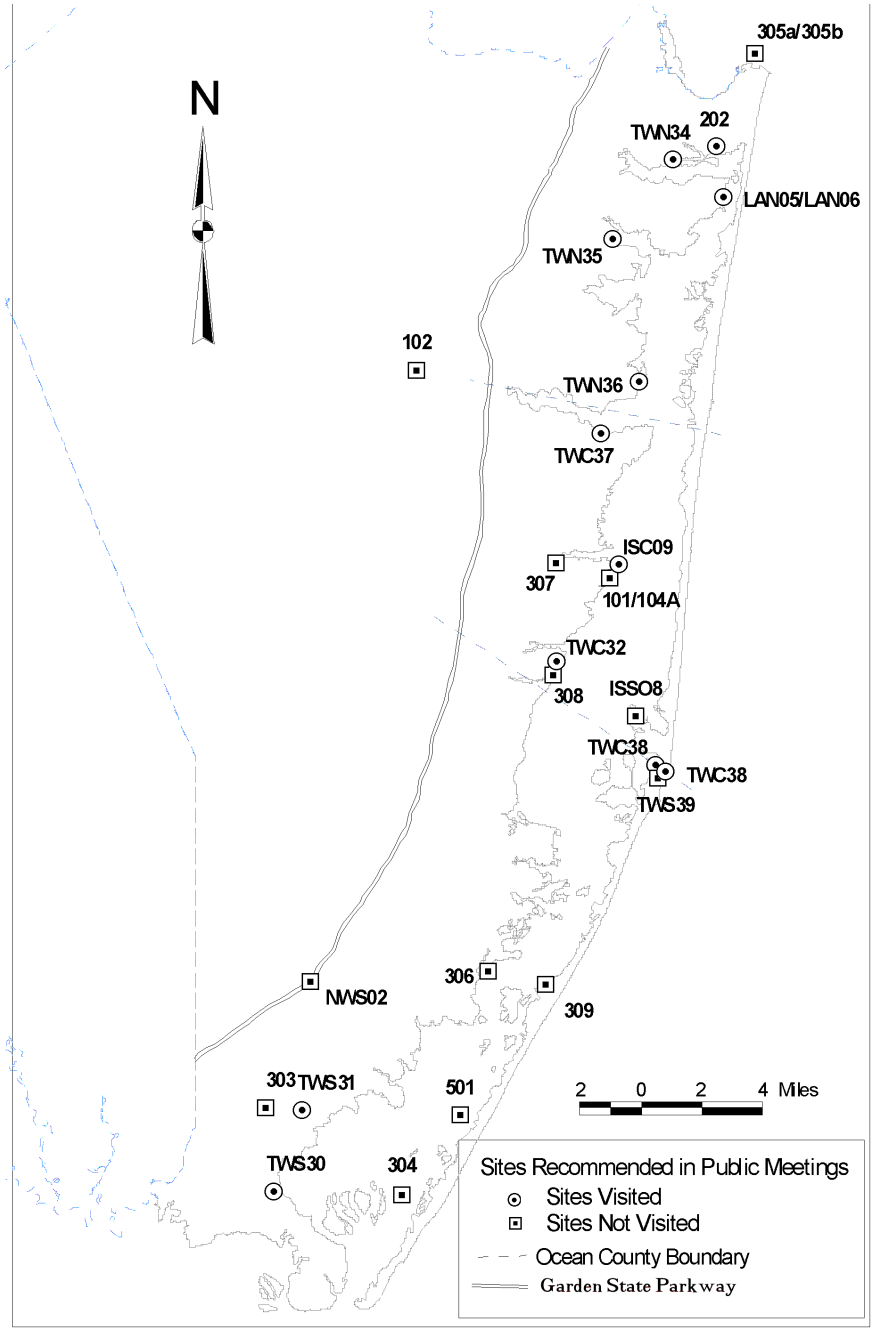


Figure 5-1. Location of all potential restoration sites recommended during the Barnegat Bay public workshops and meetingws with the BBEP Management Committee, including those visited by Versar to obtain additional information

Figure 5-1. Locations of all potential restoration sites recommended during the Barnegat Bay public workshops, including those visited by Versar to obtain additional information

6. INVESTIGATION OF FIELD SITES

The approach to the field investigation was based on the scope of work developed by the USACE and Versar=s experience evaluating potential restoration sites. To a large extent, we relied on our experience conducting a similar investigation for the USACE, Baltimore District in the Buffalo Creek, PA watershed (Southerland et al. 1999). For the Barnegat Restoration Site Selection field investigation, Steve Harriott, Versar=s wetlands ecologist, supervised the investigation of all field sites. During the reconnaissance and kick off for the field investigation, Versar met with the USACE to calibrate field observations.

6.1 FIELD INVESTIGATION METHODS AND QUALITY ASSURANCE

The field team maximized the number of sites that could be visited given the constraints of logistics, data collection, and quality assurance. Where possible, field visits were planned to take advantage of the following situations:

- X Coincidence of sites with problems from more than one ecosystem type in the same area
- X Regions where many sites could be visited in a short period of time
- X Groupings of sites that could be visited by a single method (i.e., boat access or road access)

6.1.1 Logistics

Field teams were supplied with blank field sheets, GIS and topographic maps of the field sites, aerial photographs, road atlases, cameras, video recorders, and differential GPS. Access to the terrestrial sites was usually obtained from the nearest road crossing. Because the vast majority of the sites were owned by NJDEP, USFWS, Ocean County, or other agencies, landowners were rarely encountered. Access was not denied at any of the Barnegat sites. In general, sites were visited from south to north in the watershed, with several exceptions (access by boat was constrained by weather, tide, and other conditions). A total of three sites could not be positively located; another two sites had been so significantly altered that they were considered Anon-sites;@ and two more sites were discovered to be relatively undegraded sites and therefore not reasonable candidates for restoration.

6.1.2 Data Collection

The Versar field team, led by Mr. Harriott, consisted of at least two wetlands biologists working concurrently; they were occasionally joined by Versar aquatic biologists. The Versar team was joined during the first week of the field investigations by Ms. Marlene Cole, a doctoral candidate from Rutgers University with experience in the wetlands of the region. Separate field sheets for each ecosystem type were used (Appendix B). Based on discussion with the USACE, Versar included some non-ecological parameters that are important to ultimate restoration

project success. Each of the data fields were completed, providing information such as project type, ownership, land cover, area of site, quantity of excavation required, access, presence of utilities, side slopes, hydrology inputs, receiving stream, and notes and sketches. Completed data sheets are included in Appendix B. Narrative comments and hand-drawn maps on the field sheets were also encouraged and field investigators were directed to note any information that might be useful in evaluating restoration sites. In addition, field staff photographed and videotaped (the VHS videos contain audio and video accounts) each site.

The field visits were divided among four field sessions; a total of 66 sites were visited. During the first session (November 29 to December 3, 1999), 22 sites were visited; most of these were readily accessible tidal and nontidal wetlands and abandoned lagoons. During the second session (December 6 to December 9, 1999), a total of nine readily accessible tidal and nontidal wetlands and sites only accessible by boat (islands, tidal wetlands, and abandoned lagoon sites) were visited. During the third field session (December 20 to December 23, 1999), a total of 23 readily accessible nontidal wetlands and boat-only sites were visited. A total of 12 sites suggested by members of the public during the January 25, 2000 public workshop was visited during the fourth session, beginning on February 17, 2000.

A number of potential restoration sites were discovered in the process of visiting sites identified through map study, GIS screening, or outside recommendations. These sites arose because visual inspection noted the presence of extensive areas of phragmites, areas of fill, structures in wetlands, and areas with obvious hydrological modifications. These sites included tidal and nontidal wetlands sites, abandoned lagoons, abandoned cranberry bogs, and islands. It should be noted that a number of these field-discovered sites were eliminated from the candidate site list, because (1) there was no access or (2) initial impressions were not supported (i.e., the sites were found not to be degraded).

The following is a list of sites discovered in the field and added as candidate restoration sites:

- X <u>Tidal and nontidal wetlands</u>**.** TWS06, TWS18, TWS23, TWS24, TWS25, TWC26, and NWS03
- X <u>Abandoned lagoons</u>**.** LAC02, LAC03
- X <u>Abandoned cranberry bogs</u>**.** TWS02
- X <u>Islands</u>**.** ISS02, ISS03, ISN05, ISS07, ISC08

6.1.3 Quality Assurance

Standard field sheets for each ecosystem type were drawn from similar watershed studies and customized for this project. The field sheets facilitated comparability among sites and with previous studies; Mr. Harriott also provided consistency through his supervision of all field sheets. The collection and recording of data were carefully checked during each step of the field investigation phase. The field investigators worked closely with USACE during the project

kickoff and subsequent field visits to standardize field sheet entries. Identification of site locations was calibrated with aerial photographs, topographic maps, field notes, sketches, and photographs. During the evaluation step, information on the field data sheets was reviewed by the two field investigators familiar with the project; each investigator identified non-intuitive results and checked each other=s entries for omissions or errors. These corrections were carried through all documentation. In addition, the site lists were updated, site names were revised, and data entry errors were corrected.

6.2 GENERAL ENVIRONMENTAL PROBLEMS ENCOUNTERED IN THE FIELD

During field investigation, field crews observed several kinds of general problems throughout the watershed. These problems, singly or in combination, account for most of the restoration opportunities in the Barnegat Bay ecosystem. The following is a brief summary of these problems:

X Altered drainage of tidal wetlands. Man-made features, such as mosquito ditching, open water marsh management ponds, and drainage channels are ubiquitous in most of the study area's tidal wetlands. Very few large unditched areas of marsh exist. These features have altered the hydrology of the tidal marshes, lowering vegetative and biological diversity. Some of the marshes are altered to the point where they are minimally tidal or actually nontidal; many support dense, extensive, monotypic stands of invasive phragmites.

X Phragmites. Large, monotypic stands of phragmites are pervasive in much of the study area. While phragmites may provide some erosion control and occasional, temporary cover for wildlife, it is generally an invasive, nuisance plant. When physical conditions permit (the plant tolerates a wide range of conditions), phragmites forms large, monotypic stands. The plant provides no food source for wildlife; the stands are also often too dense for wildlife use. The dense stands crowd out other native vegetation. Phragmites was found on many of the island sites investigated, where it prevents use of these sites by colonial nesting birds (many of which prefer open, unvegetated sandy habitats). Once established, phragmites can only be successfully eradicated with a series of herbicide treatments (often coupled with burning and a return to natural hydrology).

X Wetlands losses and waterway modifications. Development of lagoons and other structures to support residential communities and commercial activities is apparent throughout the coast from north to south. Most of these developments have resulted in direct losses of wetlands. Remaining waterways have been dredged and are often bulkheaded, disturbing the hydrologic flow in adjacent wetlands. Several failed lagoonal developments were investigated (i.e., abandoned lagoon sites); most date from the 1960s and 1970s. The abundance of abandoned lagoons in the study area may contribute to degraded water quality since they capture (not filter as wetlands do) the cumulative pollution from nonpoint sources and personal watercraft. Boating activities also degrade waterways through direct impacts to SAV and tidal marsh.

- Cranberry bogs. A number of cranberry bogs were encountered and investigated during the fieldwork; many were apparently abandoned. Several of the bogs contained large open water ponds, dammed by man-made water control structures and berms. While these abandoned bogs provide some pond habitat, they differ from the natural wetlands habitat of the area. Because the physical requirements to grow cranberries (i.e., wet freshwater environments, acidity, sandy soils) can be found in Atlantic white cedar wetlands, many cranberry bogs were developed in these wetlands. Because of this loss, Atlantic white cedar wetlands are now a protected habitat. Most of the abandoned bogs contained open water ponds too deep for Atlantic white cedars, but were often surrounded by Atlantic white cedar wetlands at their margins. In several of the bog sites investigated, it appeared to be possible to drain the bog ponds, reestablish historic streamflows, and restore Atlantic white cedar wetlands. It should be noted that water control structures and berms at several cranberry bog sites also appeared to block the migration of anadromous fish.

- Fill and excavation in wetlands. Many of the tidal and nontidal wetlands sites we observed contained fill, resulting in wetlands loss, hydrological modifications, and invasion and colonization by nuisance vegetation such as phragmites. The fills in tidal wetlands were most often dredging related (and appeared fairly old). The fills in nontidal areas were often associated with housing developments, utility rights-of-way, and roads. Several filled utility conduits (that are now above water level) could potentially be buried to improve hydrological conditions in existing wetlands. In several sites, the nontidal wetlands were extensively modified by excavations for stormwater facilities in housing and commercial developments.

7 EVALUATION OF CANDIDATE RESTORATION SITES

Evaluation of the candidate restoration sites is the final phase in selecting the best restoration opportunities in the Barnegat Bay ecosystem. Its goal is to make sense of the diverse information gathered from the GIS screening and field investigation phases, and to recommend sites to be pursued as restoration projects by the USACE and NJDEP. To accomplish this, we developed a tiered decision process that includes (1) scoring individual sites based on anticipated ecological benefits of the proposed restoration project, (2) modifying these scores based on the likelihood of restoration success, and (3) comparing anticipated benefits with projected economic feasibility (Figure 7-1). As in the GIS screening phase, criteria that are scientifically developed and carefully applied are the key to this evaluation. Each tier in the decision process has criteria with thresholds determining the values assigned to each site. In general, low, medium, or high scores are assigned for each criteria. This reflects the level of precision that can be obtained from this semi-quantitative evaluation. A few criteria are scored simply as yes or no. In keeping with our approach throughout the site selection, each ecosystem type is evaluated separately.

7.1 EVALUATION AND SCORING OF SITES BY ECOSYSTEM TYPE

For each ecosystem type, we describe the results of the evaluation process as follows:

- By listing the **specific evaluation criteria** and discussing how they are used
- By **ranking all sites** in a table based on scores attributable to (1) potential site-specific ecological benefits, (2) potential area-wide ecological benefits (i.e., those related to linked projects that may provide greater than additive benefits to the watershed or local ecosystem), and (3) the likelihood of the benefits being realized through successful restoration
- By designating sites attaining a threshold score above which we are confident of substantial restoration success as "**best bets**"
- By designating a few sites with especially high scores as "**best values**"

We anticipate that the USACE and NJDEP will ultimately choose final restoration sites based on a variety of information, including data not currently available. For this reason, individual scores for each parameter are shown in the tables. It should also be noted that while only a limited number of sites are likely to become USACE/NJDEP restoration projects under this feasibility study, other sites receiving high restoration scores in this site selection process could be undertaken by interested parties at a later date.

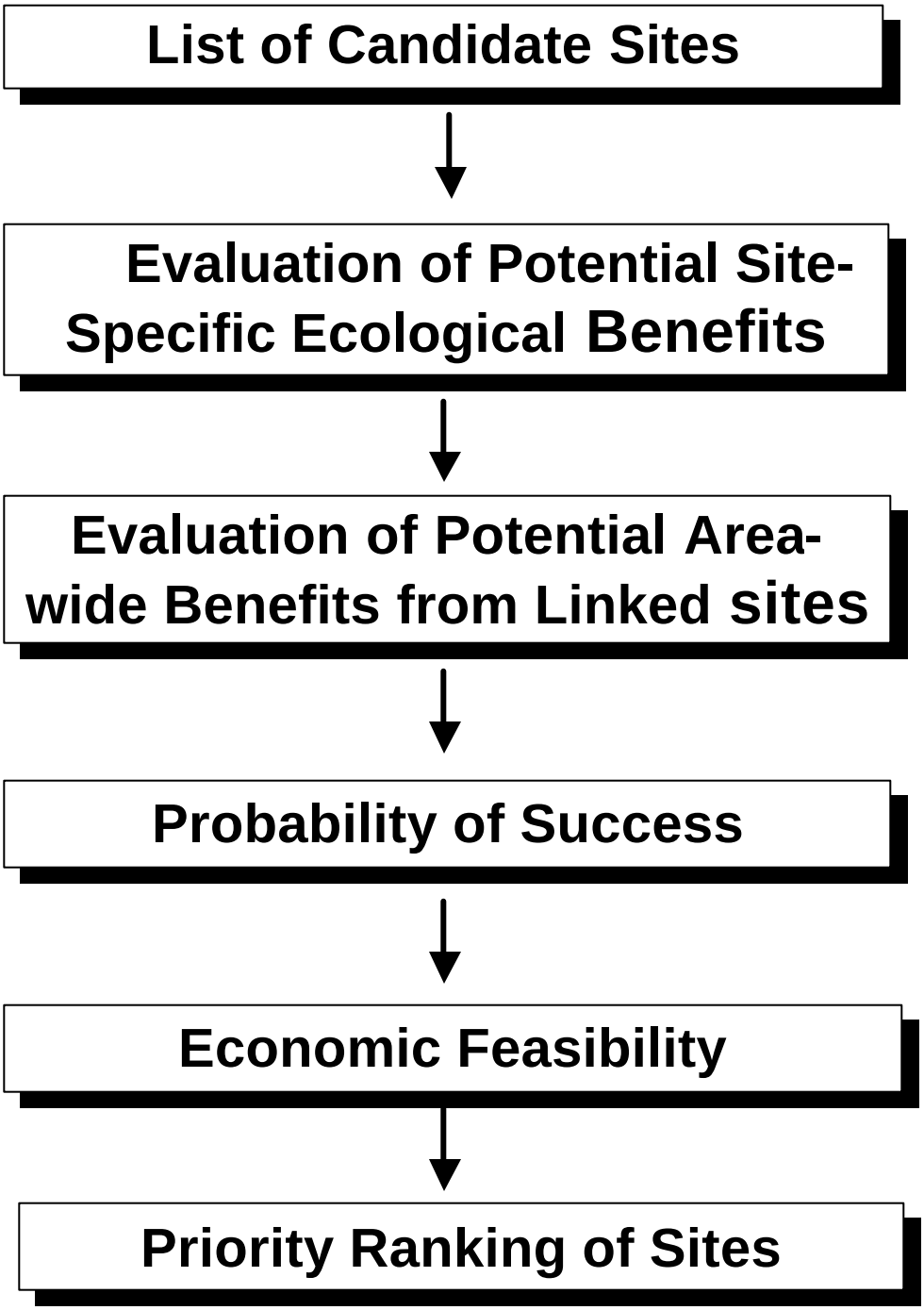


Figure 7-1. Tiered decision process for evaluating and scoring potential restoration sites.

7.1.1 Tidal and Nontidal Wetlands Sites

A total of 52 tidal and nontidal wetlands sites were selected throughout the Barnegat Bay study area from GIS screening, field discoveries, and resource agent and public recommendations. All sites were visited, evaluated, and scored using four site-specific ecological criteria, two area-wide criteria, the likelihood of restoration success, and three economic feasibility criteria (Table 7-1).

Most of the criteria were assigned weights of high, moderate, and low (i.e., scores of 3, 2, or 1); others were scored yes or no (3 or 0). The rationale for assigning each score depended on the individual criterion and is described below.

Site-specific Ecological Benefits

Benefits to existing vegetative communities. A high score on this criterion indicates that the project would likely increase the structural and ecological diversity of existing vegetative communities. A variety of native species and communities would likely predominate as a result of the project. The presence of phragmites at the sites was also incorporated into this criterion. On several sites, phragmites exists as a virtual monoculture, decreasing vegetative diversity (and the value to native wildlife; see Wildlife benefits, below). Removal of phragmites would directly benefit ecological conditions at the restoration site by allowing recolonization by a more diverse suite of native vegetation (e.g., *Spartina* spp., bulrushes, sedges, and swamp rose mallow in marsh habitats; Atlantic white cedar and red maple forest complexes in forested habitats). It should also be noted that vegetative complexes such as Atlantic white cedar wetlands and freshwater tidal wetlands are themselves increasingly rare, and typically possess a suite of associated threatened and endangered species (such as swamp pink, *Helonias bullata*, and bog asphodel, *Narthecium americanum*; see Rare, threatened, and endangered species/communities benefits, below); restoration of these complexes would help to protect such species of concern. A high score was assigned to sites where existing vegetative diversity was very low (i.e., the total number of species was low), but could be greatly improved through restoration. Moderate scores were assigned to sites where the number of existing species and community structure was moderately diverse, but could be improved through restoration. A low score was assigned where the site possessed relatively undisturbed native flora that would not be expected to improve with restoration (high = 3, moderate = 2, low = 1).

Wildlife benefits. A high score on this criterion indicates that a diversity of native terrestrial or aquatic wildlife species would likely benefit from the project. Most or all of the requisite life requirements for wildlife (including, but not limited to feeding, cover, and breeding opportunities) would be improved as a result of the project. In particular, structural vegetative and physical habitat diversity could be improved. Examples of native wildlife that could benefit from the project include anadromous and non-anadromous fish (e.g., river herring, striped bass, and largemouth bass), aquatic birds (e.g., Virginia rail, great blue heron, snowy egret, black skimmer, American oystercatcher, least tern, piping plover, and black duck), amphibians and reptiles (e.g., gray and pine barrens tree frogs, chorus frog, leopard frog, diamondback terrapin,

Table 7-1 Potential tidal and nontidal wetland restoration sites in the Barnegat Bay ecosystem. Sites above the dark line are “best bets” for restoration; shaded sites are “best valued” sites.

		Site-Specific Ecological Benefits				Area-Wide Ecological Benefits			Probability of Success	Economic Feasibility			
Site I.D.	**Total score** (max. 27)	**Benefits to existing vegetative communities** high = 3 moderate = 2 low = 1	**Wildlife benefits** high = 3 moderate = 2 low = 1	**Rare, threatened & endangered species** high = 3 moderate = 2 low = 1	**Anadromous fish passage** large benefit = 3 moderate benefit = 2 low or no benefit = 1	**Adjacent to other restoration sites** within 500 feet = 3 not linked = 0	**Other sites in same sub-watershed** yes = 3 no = 0		**Sub-total** (max. 18)	**Likelihood of restoration success** certain = 1.0 none = 0	**Ownership** USACE/state = 3 Other Federal/local = 2 private = 1	**Potential integration with other sites** potential link = 3 no link = 0	**Relative potential costs** low = 3 moderate = 2 high = 1	**Sub-total** (max. 9)
TWS15	22.4	3	3	3	1	3	3		16	0.9	3	3	2	8
TWS17	22.4	3	3	3	1	3	3		16	0.9	3	3	2	8
TWS18	22.4	3	3	3	1	3	3		16	0.9	3	3	2	8
TWS23	20.6	3	3	1	1	3	3		14	0.9	3	3	2	8
TWS24	20.6	3	3	1	1	3	3		14	0.9	3	3	2	8
TWS25	20.6	3	3	1	1	3	3		14	0.9	3	3	2	8
NWS02	18.9	3	2	3	3	3	3		17	0.7	2	3	2	7
NWS01	18.6	2	3	3	3	0	3		14	0.9	3	0	3	6
TWS39	17.7	3	3	3	1	0	3		13	0.9	3	0	3	6
TWS02	16.7	3	2	3	2	0	3		13	0.9	2	0	3	5
TWC21	16.1	2	3	3	1	0	0		9	0.9	2	3	3	8
NWS03	15.7	1	3	3	3	0	3		13	0.9	1	0	3	4
TWN28	13.4	3	3	2	1	0	3		12	0.7	2	0	3	5
TWC38	12.5	2	3	2	1	3	0		11	0.5	3	3	1	7
TWN16	12	3	3	3	1	0	0		10	0.7	3	0	2	5
TWN33	12	3	2	1	1	0	3		10	0.7	3	0	2	5
TWS22	11.5	2	3	1	1	3	3		13	0.5	3	0	2	5
TWSO3	11	3	2	1	1	0	3		10	0.5	3	0	3	6
TWS06	10	2	2	1	1	0	0		6	0.5	2	3	2	7
TWS31	10	1	1	1	1	3	3		10	0.3	3	3	1	7
TWS30	9.6	1	1	1	1	0	0		4	0.9	3	0	3	6
NWS06	9.6	2	2	1	1	3	3		12	0.3	1	3	2	6
TWSO5	9.5	3	2	1	1	0	0		7	0.5	1	3	2	6
TWS01	9.5	2	1	1	1	0	n/a		5	0.5	3	3	1	7
TWS04	8.6	1	1	1	1	0	n/a		4	0.9	2	0	3	5
TWC37	8.5	1	1	1	2	0	0		5	0.9	2	0	2	4
TWN34	8.4	2	1	1	1	0	3		8	0.3	3	0	3	6
TWC32	8.2	1	1	1	1	0	0		4	0.3	3	3	1	7
TWN35	8.2	1	1	1	1	0	0		4	0.3	3	3	1	7
TWS26	8	3	3	1	1	0	0		8	0.5	3	0	1	4
NWN11	8	1	2	2	1	0	0		6	0	2	3	3	8
NWN05	7.2	1	1	1	1	0	n/a		4	0.3	2	3	1	6
TWN27	7.1	1	1	1	1	0	3		7	0.3	3	0	2	5
TWN29	7	2	2	1	1	0	n/a		6	0.5	2	0	2	4
TWN19	6.7	3	3	2	1	0	0		9	0.3	2	0	2	4
TWC10	6	2	2	1	1	0	0		6	0.5	1	0	2	3
TWC12	6	1	1	1	1	0	n/a		4	0	2	3	1	6
TWSO8	5.8	2	2	1	1	0	0		6	0.3	3	0	1	4
TWN36	5.5	2	1	1	1	0	0		5	0.5	2	0	1	3
TWN14	5.4	3	3	1	1	n/a	0		8	0.3	2	0	1	3
NWC07	5.4	2	2	3	1	0	0		8	0.3	1	0	2	3
NWN09	5.4	2	2	3	1	0	0		8	0.3	1	0	2	3
TWC11	5.2	1	1	1	1	0	0		4	0.3	1	0	3	4
TWS09	5.2	1	1	1	1	0	0		4	0.3	2	0	2	4
TWC20	5.1	3	2	1	1	0	0		7	0.3	2	0	1	3
NWC08	4.8	1	1	3	1	0	0		6	0.3	1	0	2	3
NWS04	4.5	2	1	1	1	0	0		5	0.3	1	0	2	3
TWN13	3.8	2	2	1	1	0	0		6	0.3	1	0	1	2
TWS07	0	n/a	n/a	n/a	n/a	n/a	n/a		0	0	n/a	n/a	n/a	0
NWN10	0	n/a	n/a	n/a	n/a	n/a	n/a		0	0	n/a	n/a	n/a	0
NWN12	0	n/a	n/a	n/a	n/a	n/a	n/a		0	0.5	n/a	n/a	n/a	0
NWN13	0	n/a	n/a	n/a	n/a	n/a	n/a		0	0	n/a	n/a	n/a	0

Total Score = (Potential Ecological Benefits x Probability of Success) + Economic Feasibility.

and water snakes), and mammals (e.g., river otter, mink, long-tailed weasel, and marsh rice rat). As described above (under Benefits to existing vegetative communities), removal of large quantities of phragmites at any site (and its subsequent replacement with native vegetation) would also have direct positive benefits on wildlife. Successful removal of phragmites would provide greater feeding, cover, and breeding opportunities for most species of native wildlife. A high score was assigned to sites where existing habitats were poor, but could be greatly improved through restoration. Moderate scores were assigned where existing habitats had some value to wildlife, but could be improved through restoration. A low score was assigned where existing habitats were believed to be of relatively high quality or where restoration of habitat was not likely to be appropriate (high = 3, moderate = 2, low = 1).

Rare, threatened, and endangered species/communities benefits. Federal or state threatened or endangered plant or animals species or rare communities (e.g., Atlantic white cedar wetlands) were occasionally found to exist in the vicinity of sites. It appeared likely that the species or community of concern at some of these sites would benefit if a restoration action were implemented. A high score was applied to this criterion when a particular species, group of species, or community of concern was known to exist at or directly adjacent to a site (either from NJDEP Heritage information or from field studies) and whose population could potentially benefit from restoration actions at the site. Plant and animal species and communities of concern either observed by Versar or otherwise known to exist at the sites included swamp pink, bog asphodel, black skimmer, northern harrier, and Atlantic white cedar wetlands (the latter are afforded regulatory permitting protection by NJDEP), and freshwater tidal wetlands (which are increasingly rare region-wide). A high score was assigned where species/communities of concern were known to exist on or directly adjacent to the site, and where restoration actions would directly benefit such species/communities. Moderate scores were assigned where some ties to species/communities of concern were present, but where restoration of the site may not be practical at present (e.g., because of incompatible land uses, parcel size issues, or uncertain restoration techniques). A low score was applied where no species/communities of concern were known or observed to be present, where the species observed was judged to be transient, or where restoration to benefit them was deemed to be impractical (high = 3, moderate = 2, low = 1).

Anadromous fish passage. The potential exists for opening several waterways in the study area to anadromous fish by removing relatively simple structures (e.g., cranberry bog water control structures, small berms, and dikes). Note that this criterion does not consider the construction of fish ladders or other passage facilities at the several large dams in the study area (see the Fish Passage section, below). This criterion does take into account the presence of additional blockages on the same stream (which were investigated on a case-by-case basis during the field studies) and the number of stream miles that would be opened to passage through implementation of a project (which was determined by inspecting maps). Information on other parameters potentially critical to the passage of anadromous fish (e.g., water chemistry, phytoplankton counts) was not collected as part of the wetland site selection field studies and these factors were not evaluated. A large benefit was assigned to sites where no other fish blockages were apparent and the quantity of potential upstream habitat was large. Moderate benefits were assigned to sites where other small upstream or downstream blockages were observed, where a smaller quantity of upstream habitat was present, or where both occurred. Low or no

benefit was assigned where there was only a slight chance or no chance of opening a stream to anadromous fish passage (large benefit = 3, moderate benefit = 2, low or no benefit = 1).

Area-wide Ecological Benefits

Adjacent to other restoration sites. Restoration sites that are in close proximity to each other likely provide greater than additive ecological benefits. If two or more sites were within 500 feet of each other, they were considered to be ecologically linked and received a score of 3. This distance threshold is based on best professional judgment and reflects the likelihood that ecosystem processes such as hydrology or species movement link the sites. A score of 0 was assigned to non-adjacent sites (within 500 feet = 3, not linked = 0).

Other sites in same sub-watershed. The restoration of sites within the same sub-watershed has the potential to provide greater than additive ecological benefits through the same ecosystem processes as described for adjacent sites, but to a lesser degree. For the purposes of this study, sub-watersheds were designated by the catchment draining into any main tributary stream to Barnegat Bay (e.g., Kettle Creek, Toms River, or Westecunk Creek). Sites in the same sub-watershed may or may not be adjacent (i.e., within 500 feet of each other). All sites within the same sub-watershed were assigned a score of 3. Sites not in the same sub-watershed or those directly on Barnegat Bay were assigned a score of 0 (yes = 3, no = 0).

Probability of Success

Each of the wetlands sites was also assigned a Probability of Success multiplier score, ranging in tenths from 1.0 (certain success) to 0 (no probability of success). Sites that would be relatively easy to restore (e.g., those requiring removal of phragmites only or removal of small, partially-breached structures or dikes) were most often assigned high scores. Removing phragmites is not trivial, but has a high success rate when a series of herbicide treatments are used, often in connection with burning or reinstitution of tidal influence. Conversely, large-scale sites requiring complex solutions with less certain outcomes (e.g., removal of large amounts of material, large areas to be regraded and replanted, and removal of large structures or dams) were assigned lower scores.

Economic Feasibility

Ownership. The Federal agency undertaking this project is the USACE; the non-Federal partner is the NJDEP. USACE or state (NJDEP) ownership would simplify project implementation since there would be no ownership conflicts. Other Federal or local government ownership would facilitate transactions, but coordination would be required. Private ownership could make project implementation expensive or impossible (USACE/state = 3; other Federal/local = 2; private = 1).

Potential integration with other sites. Sites that could be linked during implementation would likely be more economically feasible. For example, sandy fill materials removed from berms to restore a tidal wetland site could potentially be used to create open, sandy habitats for beach-nesting birds on a nearby island site, or to fill dredged hole sites for improvements of

benthic and fish habitats. Such integrated sites could be less expensive to implement (e.g., by saving on transportation costs, as well as the costs of fill material) and would facilitate implementing several projects in the same general area. Both "donor" sites (i.e., sites with clean, sandy fill to be removed) as well as "receiver" sites (sites that would require clean, sandy fill for their restoration) were considered as "linked" sites (potential link = 3; no link = 0).

Relative potential costs. Projects that require removing or moving large quantities of fill or other materials (e.g., those requiring large equipment, incurring substantial transportation costs, and necessitating permits) will be inherently more expensive than projects with relatively easy fixes (e.g., phragmites eradication). Projects requiring expensive, complex solutions were assigned a high cost score. Moderate costs could apply to projects with combinations of fixes (i.e., some phragmites eradication and small quantities of material removal or moving); these were assigned a moderate score. A low score was assigned to projects with relatively easy, certain solutions (low = 3; moderate = 2; high = 1).

Site Selections

Each of the above criteria were used in the final evaluation of individual sites. First, all site-specific criteria scores (two thirds of subtotal) and area-wide criteria scores (one third of subtotal) for each site were summed for a composite potential ecological benefit score (maximum score of 18). Next, the probability of success score (maximum of 1.0) was multiplied by the composite ecological benefits scores to produce the likely ecological benefit for each site (maximum of 18). Then, the expected ecological benefit score for each site was summed with the economic feasibility score (maximum 9), for a final total site score (maximum of 27). By combining these scores as a sum, two-thirds of the sites final score results from the expected ecological benefit (potential benefit x probability of success) and one-third from the economic feasibility. The designation of thresholds for selecting best bet and best value sites was a combination of semi-quantitative evaluation and best professional judgment. As is commonly done with ecological data, analysts looked for clear "breaks" in this range of scores and used additional knowledge (especially that obtained in the field) to confirm differences among sites.

A threshold total score of 15 was chosen to designate sites as best bets for tidal and nontidal wetlands restoration, producing the following 12 sites:

Best Bets

X TWS15, South of West Creek, on Westecunk Creek
X TWS17, South of West Creek, on Westecunk Creek
X TWS18, South of West Creek, on Westecunk Creek
X TWS23, South of West Creek, on Westecunk Creek (near mouth of river)
X TWS24, South of West Creek, on Westecunk Creek (near mouth of river)
X TWS25, South of West Creek, on Westecunk Creek (near mouth of river)
X NWS02, North of West Creek, immediately north of Garden State Parkway (Stamford Forge WMA)
X NWS01, 0.5 mile south of Rt. 72/Rt.9 interchange (Cedar Run abandoned

cranberry bog)

X TWS39, Immediately south of Barnegat Inlet, along beach (Barnegat Light South)

X TWS02, 2 miles southwest of Tuckerton, off Route 9 (south side) (Ballanger Creek abandoned cranberry bog)

X TWC21, Left bank of Oyster Creek, near mouth (Oyster Creek dredged materials disposal site)

X NWS03, Silver Lake area of West Creek, immediately north of Route 9 (Silver Lake small structure removal)

Six sites (all tidal wetlands in the south region) were designated as best values with final site scores greater than 20 (74% of the maximum). It should be noted that the first three sites are linked geographically and ecologically, as are the second three. Choosing only one site of a linked set would reduce its ecological benefit by removing the area-wide contribution. In addition, the three top-ranked best value sites (TWS15, TWS17, TWS18) may also provide integration with other restoration in the area, in that they could provide clean, sandy fill (by removal of berms and other structures) for use at other restoration sites.

Best Values

X TWS15

X TWS17

X TWS18

X TWS23

X TWS24

X TWS25

7.1.2 Abandoned Lagoon Sites

The same criteria and scoring methods used for potential tidal and nontidal wetlands restoration sites were also applied to abandoned lagoon sites, with certain modifications (refer to Section 7.1.1). As discussed earlier, all abandoned lagoon sites were essentially tidal wetlands, were usually visited in conjunction with other tidal wetlands sites, and exhibited similar restoration opportunities. A total of six abandoned lagoon sites were selected throughout the Barnegat Bay study area from GIS screening, field discoveries, and resource-agent and public recommendations (Table 7-2). The following describes the criteria used to evaluate the abandoned lagoons (highlighting the differences from the wetlands criteria):

Site-specific Ecological Benefits

Benefits to existing vegetative communities. The criteria for evaluating potential benefits to existing vegetative communities were the same as those used for wetlands, with a few exceptions. A higher proportion of the lagoon sites was open water (owing to the channels cut for navigation from the Bay or streams into the lagoons). Also some, but not all of these sites contained degraded upland habitats (usually on top of the side-cast fill left when the lagoon

channels were cut); conversely, a slightly smaller proportion of the sites was typically dominated by phragmites. The lagoon sites were always bordered by tidal marsh, in various states of human-influenced disturbance. Benefits to existing communities were consequently viewed as a combination of potential improvements to upland habitats and existing degraded tidal marsh, and the potential for reestablishment of new tidal marsh in open water areas. A high score was assigned to sites where existing (upland and wetland) vegetative diversity was very low, but could be expected to be restored to the condition of high quality tidal wetlands (and uplands, where applicable). Moderate scores were assigned to sites where the composition and structure of both upland and wetland communities was moderately diverse, but could be improved through restoration (but where no adjacent high quality existing wetlands were present). A low score was assigned where the site possessed relatively undisturbed native flora that could not practically be expected to improve with restoration (high = 3, moderate = 2, low = 1).

Wildlife benefits. The criteria for evaluating wildlife benefits were the same as those used for wetlands, with the exception of considering phragmites cover (abandoned sites did not typically possess substantial phragmites cover). A diversity of native terrestrial and aquatic wildlife species would likely benefit from project implementation. Most or all of the requisite life requirements for wildlife (including, but not limited to feeding, cover, and breeding opportunities) would be improved as a result of the project. Structural vegetative and physical habitat diversity could be provided with restoration, resulting in the likelihood of improved feeding, cover, and breeding opportunities for wildlife. Examples of native wildlife that could benefit from project implementation could include anadromous and non-anadromous fish (e.g., river herring, striped bass, largemouth bass), aquatic birds (e.g., Virginia rail, great blue heron, snowy egret, black skimmer, American oystercatcher, least tern, piping plover, black duck), amphibians and reptiles (e.g., gray and pine barrens tree frogs, chorus frog, leopard frog, diamondback terrapin, water snakes), and mammals (e.g., river otter, mink, long-tailed weasel, marsh rice rat). A high score was assigned to sites where existing habitats were poor, but could be greatly improved through restoration. Moderate scores were assigned where existing habitats at a site were of some value to wildlife, but could be improved through restoration. A low score was assigned where existing habitats were believed to be of relatively high quality or where restoration of habitat was not likely to be successful (high = 3, moderate = 2, low = 1).

Rare, threatened and endangered species/communities benefits. The same considerations were used for this criterion as were used for the wetlands sites. None of the six abandoned lagoon sites visited, however, possessed any known plant, animal, or adjacent vegetation community of particular concern; all were assigned a low ranking for this category (high = 3, moderate = 2, low = 1).

Anadromous fish passage. The same considerations were used for this criterion as were used for the wetlands sites. None of the six abandoned lagoon sites visited, however, possessed any known fish blockages; all were assigned a low ranking for this category (large benefit = 3, moderate benefit = 2, low or no benefit = 1).

Table 7-2. Potential abandoned lagoon restoration sites in the Barnegat Bay ecosystem. Sites above the dark line are “best bets” for restoration; shaded sites are “best value” sites.

		Site-Specific Ecological Benefits				Area-Wide Ecological Benefits				Probability of Success	Economic Feasibility			
Site I.D.	**Total score** (max. 27)	**Benefits to existing vegetative communities** high = 3 moderate = 2 low = 1	**Wildlife benefits** high = 3 moderate = 2 low = 1	**Rare, threatened & endangered species** high = 3 moderate = 2 low = 1	**Anadromous fish passage** large benefit = 3 moderate benefit = 2 low or no benefit = 1	**Adjacent to other restoration sites** within 500 feet = 3 not linked = 0	**Other sites in same sub-watershed** yes = 3 no = 0		**Sub-total** (max. 18)	**Likelihood of restoration success** certain = 1.0 none = 0	**Ownership** USACE/state = 3 Other Federal/local = 2 private = 1	**Potential integration with other sites** potential link = 3 no link = 0	**Relative potential costs** low = 3 moderate = 2 high = 1	**Sub-total** (max. 9)
LAN05	16.8	3	3	1	1	3	3	3	14	0.7	2	3	2	7
LAN06	16.8	3	3	1	1	3	3	3	14	0.7	2	3	2	7
LAC02	15.8	3	3	1	1	3	3	3	14	0.7	2	3	1	6
LAC03	13	3	3	1	1	3	3	3	14	0.5	2	3	1	6
LAN04	7.5	2	2	1	1	0	3	3	9	0.5	1	0	2	3
LAS01	5.5	1	2	1	1	0	0	0	5	0.3	2	0	2	4

Total Score = (Potential Ecological Benefits x Probability of Success) + Economic Feasibility.

Area-wide Ecological Benefits

Adjacent to other restoration sites. The same considerations were used for this criterion as were used for the wetlands sites. Restoration sites that are in close proximity to each other likely provide greater than additive ecological benefits. If two or more sites were within 500 feet of each other, they were considered to be directly ecologically linked, and received a score of 3. A score of 0 was assigned to non-adjacent sites (within 500 feet = 3, not linked = 0).

Other sites in same sub-watershed. The same considerations were used for this criterion as were used for the wetlands sites. The restoration of sites within the same sub-watershed has the potential to provide greater than additional ecological benefits through the same ecosystem processes as described for adjacent sites, but to a lesser degree. For the purposes of this study, sub-watersheds were designated by the catchment draining into any main tributary stream to Barnegat Bay (e.g., Kettle Creek, Toms River, or Westecunk Creek). Sites in the same sub-watershed may or may not be adjacent (i.e., within 500 feet of each other). All sites within the same sub-watershed were assigned a score of 3. Sites not in the same sub-watershed or those directly on Barnegat Bay were assigned a score of 0 (yes = 3, no = 0).

Probability of Success

Each of the abandoned lagoons sites was also assigned a Probability of Success multiplier score, ranging in tenths from 1.0 (certain success) to 0 (no probability of success). Sites that would be relatively easy to restore (e.g., those requiring only small areas of replanting, phragmites removal, or where the side-cast fill on site could potentially be used for reestablishment of tidal wetlands) were most often assigned high scores. Conversely, large-scale sites requiring potentially complex solutions with uncertain outcomes (e.g., sites with potential access problems, removal of large amounts of material; large areas to be regraded and replanted) were assigned lower scores.

Economic Feasibility

Ownership. The same criteria were used as in the wetlands sites (USACE/state = 3; other Federal/local = 2; private = 1).

Potential integration with other sites. Abandoned lagoons, as potential receiver sites, could be linked to fill donor sites, such as tidal wetlands sites in need of removal of sandy, clean fill. For example, sandy fill materials could be imported into the lagoon as needed, to reestablish tidal marsh. Such integrated sites would likely be less expensive and would help to facilitate several projects in the same area of the watershed. Both donor sites (i.e., sites with clean, sandy fill to be removed) as well as receiver sites (sites that would require clean, sandy fill for their restoration) were considered as linked (potential link = 3; no link = 0).

Relative potential costs. Projects that require removing or moving large quantities of fill or other materials (e.g., those requiring large equipment, incurring substantial transportation costs, and necessitating permits) will be inherently more expensive than projects with relatively

easy fixes (e.g., phragmites eradication, removal of a small berm). Projects requiring expensive, complex solutions were assigned a high score. Moderate costs could apply to projects with combinations of fixes (i.e., some phragmites eradication and small quantities of material removal or moving); these were assigned a moderate score. A low status was assigned to projects with relatively easy, certain solutions. All six of the lagoon sites were assigned either a moderate or a high cost status, owing to the fact that all would require combinations of restoration fixes involving side-cast material movement, removal, and grading (low = 3; moderate = 2; high = 1).

Site Selections

Based on these criteria, a threshold total site score of 15 (56% of maximum) was used to designate the best bet abandoned lagoon sites. This threshold eliminated two sites with low potential ecological benefits and a third site with a lower probability of success.

Best Bets

X LAN05, West Mantoloking, north side of Route 528, before bridge to Long Beach Island (LBI)
X LAN06, West Mantoloking, north side of Route 528, before bridge to LBI
X LAC02, Off Bayview Avenue (south of road), near Ocean Gate community (Bayville Lagoon)

The two top scoring sites at 16.8 (62% of maximum) were designated as best values. Site LAC02 scored slightly lower under the relative potential costs portion of the economic feasibility score (i.e., costs were estimated to be high), because it appeared that the site was larger and more isolated than the others.

Best values

X LAN05
X LAN06

7.1.3 Submerged Aquatic Vegetation Sites

A total of 17 candidate sites were identified in the GIS screening phase for SAV restoration in Barnegat Bay (Table 7-3). An additional site (for a total of 18 sites) was added to represent potential SAV restoration sites outside the current range of existing SAV (at the suggestion of Paul Bologna, an SAV scientist from Rutgers University). It should be noted that owing to the uncertainty associated with SAV restoration in Barnegat Bay, pilot studies will be needed as part of the feasibility phase to identify the optimal planting season in Barnegat Bay as well as to determine methods to minimize disturbances from human activities (e.g., hydroplaning and rafting of watercraft in shallow areas). Given the general uncertain success of SAV restoration, the literature (Fonseca 1989) and local expertise (Paul Bologna, Rutgers University, personal communication) indicate that large areas in historical and current SAV distributions are the best prospects for restoration efforts.

Evaluation Criteria

X Size of contiguous areas previously supporting SAV
X Distribution among regions of Barnegat Bay to address unknown variables

The 17 SAV sites identified in the GIS screening process (using the following exclusionary criteria Cwater depth between 1 and 2 meters, size of area greater than 10 acres, distance of area from the navigation channel greater than 100 meters, adequate light penetration not in western half of the Bay, and adjacent to existing SAV areas) and the 18th recommended site (SAS18; which met all of the GIS screening criteria with the exception that it was not adjacent to an existing SAV bed), were sorted by the size of each site, in descending order. The size of each site was the contiguous area of Bay bottom meeting all exclusionary criteria. The size of the site is a good predictor of restoration success, because it provides a larger area within which to find ideal conditions for planting. In addition, once restored, larger sites are more likely to provide greater habitat benefits than smaller sites. The size of the SAV candidate sites ranged from 12 acres to 161 acres (Table 7-3).

Site Selections

Considering the value of larger potential restoration areas, sites of greater than 100 acres were designated as best bets. This threshold reflects the large gap in site size after the first seven sites. Therefore, 7 sites of at least 100 acres were designated as best bets. Where these large sites are located adjacent to existing SAV beds, they have the potential to greatly increase the size and available habitat provided by existing patches of SAV.

Best Bets

X SAN02, SAV area in north region
X SAS18, SAV area in south region
X SAC07, SAV area in central region
X SAC08, SAV area in central region
X SAS17, SAV area in south region
X SAS14, SAV area in south region
X SAS15, SAV area in south region

To address the uncertainty associated with SAV restoration, we concluded that a single large (best bet) site be chosen from each region of Barnegat Bay for a pilot study. Whichever sites show promise in the pilot could be pursued as a larger-scale restoration. Therefore, the three largest sites representing the north, south, and central regions were designated as best values. By chance, all three regions are represented in the three largest sites (ranging from 129 to 161 acres). Site SAS18 (the second largest site) also provides an opportunity to pilot SAV restoration in a region without current SAV, but where SAV may only be limited by a lack of a seed source (this option was suggested by Paul Bologna). Selecting sites from the three major geographic regions of the Bay will help control for variations in environmental conditions that remain unknown, but which may affect restoration success. For example, the distribution of eelgrass *(Zostera marina)* and widgeon grass (*Ruppia maritima)* varies from south to north and one of these species may be easier to restore. In addition, distributing the sites can help control for variation in water quality conditions within the Bay, as well as possible effects from the wasting disease that has recently afflicted SAV.

Table 7-3. Potential SAV restoration sites in the Barnegat Bay Ecosystem. Sites above the dark line are "best bets" for restoration; shaded sites are "best value" sites.

Rank	**Site I.D.**	**Area** (acres)	**Adjacent existing SAV parcels** (acres)	**Site location** (East/West)
1	SAN02	160.8	232.0 and 375.0	E
2	SAS18*	131	NONE	E
3	SAC07	129.4	3063.1	E
4	SAC08	127.1	3063.1	E
5	SAS17	122.5	306.4 and 102.5	E
6	SAS14	111.4	777.5 and 240.0	E/W
7	SAS15	102.1	240.0 and 162.0	E
8	SAC04	83.7	348.6	E/W
9	SAC11	74.5	3063.1	E
10	SAC06	67.0	737.0	E
11	SAC09	64.5	3063.1	E
12	SAN01	51.9	232.0	E/W
13	SAC10	44.8	3063.1	E
14	SAN03	39.3	232.0	E
15	SAS16	22.3	306.4	E
16	SAS12	14.7	975.9	E/W
17	SAC05	14.4	348.6	E
18	SAS13	11.6	777.5	E/W

* SAS18 was suggested as a potential restoration site at the January 25, 2000 public workshop. The site met all of the exclusionary GIS criteria used to select the other SAV sites, with the exception of being adjacent to existing SAV.

Best values

X SAN02
X SAS18
X SAC07

7.1.4 Islands for Bird Habitat Sites

A total of nine candidate island sites were selected throughout the Barnegat Bay study area from GIS screening, field discoveries, and resource-agent and public recommendations (Table 7-4). Several of the same criteria and ranking methods used for the wetlands and abandoned lagoon restoration sites were applied to islands for bird habitat sites (refer to Sections 7.1.1 and 7.1.2). Restoration opportunities for the island sites as bird habitat are somewhat different, however, and the criteria were modified to reflect these differences.

Evaluation Criteria

The primary difference between the island restoration sites and the wetlands and abandoned lagoons sites is that the island bird habitat restoration opportunities lie almost exclusively in non-wetlands; candidate sites possessing large areas of wetlands (almost always S*partina* marsh, but also occasionally phragmites wetlands) were viewed as not restorable for bird habitat (and consequently received low final ranking owing to low scores in several categories). The "not-restorable" view for bird habitat on wetlands island sites was conceived for several reasons, but primarily because bird habitat projects could involve destruction of existing wetlands. The primary restoration options for improving island bird habitats involve (1) creating large open, sandy habitats for beach nesting birds and (2) planting trees and shrubs (and preserving existing trees and shrubs) to establish habitat for tree nesting birds. Because both of these options would likely require deposition of clean, sandy fill materials, existing wetlands habitats (many of them ecologically-valuable *Spartina* marsh) could be lost using these techniques. Other differences in criteria for islands were as follows: (1) benefits for anadromous fish passage are not applicable to island sites and this criterion was omitted and (2) the criterion for sites in the same sub-watershed was omitted because all of the island sites were in Barnegat Bay itself. A new criterion was added for evaluating islandsCthe distance of the island from the mainland (see below).

Distance from mainland. Island sites farthest from the mainland stand the best chance of remaining free from the non-avian predators (e.g., raccoons, foxes, snakes, and rats) that prey on adult and immature birds and their eggs. In some cases, predators are semi-permanent or permanent residents on the islands; in other cases they apparently swim to the islands or cross to the islands on winter ice. Distance from the mainland were applied to score the criterion (>2,000 feet = 3; 2,000 feet to 1,500 feet = 2; <1,500 feet = 1). This distance criterion can be modified with site-specific information on disturbance factors unrelated to distance from the mainland when it becomes available.

Table 7-4. Potential island restoration for bird habitat sites in the Barnegat Bay ecosystem. Sites above the dark line are “best bets” for restoration; shaded sites are “best value” sites.

		Site-Specific Ecological Benefits				Area-Wide Ecological Benefits		Probability of Success	Economic Feasibility			
Site I.D.	**Total score** (max. 24)	**Benefits to existing vegetative communities** high = 3 moderate = 2 low = 1	**Wildlife benefits** high = 3 moderate = 2 low = 1	**Rare, threatened & endangered species** high = 3 moderate = 2 low = 1	**Distance from mainland (islands only)** >2,000 ft. = 3 2,000 to 1,500 ft. = 2 <1,500 ft. = 1	**Adjacent to other restoration sites** within 500 feet = 3 not linked = 0	**Sub-total** (max. 15)	**Likelihood of restoration success** certain = 1.0 none = 0	**Ownership** USACE/state = 3 Other Federal/local = 2 private = 1	**Potential integration with other sites** potential link = 3 no link = 0	**Relative potential costs** low = 3 moderate = 2 high = 1	**Sub-total** (max. 9)
ISSO3	17	3	3	2	2	0	10	0.9	3	3	2	8
ISS01	16.9	3	3	3	2	0	11	0.9	2	3	2	7
ISS08	16.1	1	3	2	3	0	9	0.9	2	3	3	8
ISS02	16	2	3	2	3	0	10	0.9	2	3	2	7
ISN05	13.3	2	3	2	2	0	9	0.7	2	3	2	7
ISN06	10	3	3	2	2	0	10	0.3	2	3	2	7
ISS04	8	3	3	1	2	0	9	0	3	3	2	8
ISS07	6	1	1	1	3	0	6	0	3	0	3	6
ISC09	2	1	1	1	1	0	4	0	1	0	1	2

Total Score = (Potential Ecological Benefits x Probability of Success) + Economic Feasibility.

Site Selections

Using the six criteria for island sites, a threshold total site score of 15 (63% of maximum) was used to designate the best bet islands for bird habitat. This threshold excludes low scoring sites and those with less than 0.9 likelihood of restoration success.

Best Bets

X ISS03, Directly west of Brand Beach, LBI (High Island)
X ISS01, Immediately south of Route 72 bridge, about 0.5 mile west of Ship Bottom (Cedar Bonnet Island)
X ISS02, About 1 mile south and west of Ship Bottom, LBI (Flat Island)
X ISS08, 1.5 miles northwest of Barnegat Lighthouse (Island #26A)

The top scoring sites at 17.0 and 16.9 (71% of maximum) were designated as best values. The two sites eliminated (ISS02 and ISS08) were less likely to provide as much benefit to existing vegetation communities. Similar to the wetlands sites, all of the best bet and best value sites (ISS03, ISS01, ISS02, ISS08) may also provide integration with other restoration in the area by accepting clean, sandy fill from other restoration sites.

Best values

X ISS03
X ISS01

7.1.5 Fish Passage Sites

All 11 dams at or downstream of the Garden State Parkway were selected in the GIS screening phase for fish passage in the Barnegat Bay ecosystem. The following two criteria were used to evaluate the restoration potential at these 11 sites. It should be noted that the acidic headwaters of the watershed affect the amount of forage and habitat suitability of these streams for anadromous fish. In recent targeted studies, sampling to determine the viability of habitat opened by fish passage has been undertaken for Manahawkin Lake and Lake Pohatcong. This habitat information has been incorporated into the evaluation of these two sites, but is not available for the other sites.

Evaluation Criteria

X Presence of multiple dams on a single river system
X Watershed area upstream of the dam

During the evaluation, the 11 dams were plotted on a map of the Barnegat Bay area (Figure 4-6) to determine the presence of multiple dams on a single river system. Multiple dams on a single river system were grouped together, as any restoration project at these sites (e.g., fish ladder installation) would have to occur at all the dams on the stream to provide access to the

upstream watershed area. Specifically, the North Branch Forked River dams (Deer Head Lake, Parker Street, and Barnegat Lake) and the Kettle Creek dams (Rainbow, Lake Riviera, and Waddill Lake) are located in close proximity on their respective mainstem stream (i.e., virtually no new habitat would be opened by passing one dam alone); they are thus relegated to the bottom of the ranked list. The Holiday Lake Dam is not on the mainstem Mill Creek like Manahawkin Lake Dam, so it only blocks 6 of the 20 square miles of that watershed. In the ranking of fish passage restoration opportunities, Manahawkin Lake Dam and Holiday Lake Dam are considered separately as opening 14 and 6 square miles of watershed area, respectively. The single dams and groups of the dams on the same river system were then ranked based on the watershed area upstream of the dam (Table 7-5).

Site Selections

Based on this evaluation, the order of single dams scoring the highest (opening the greatest watershed area) are Double Trouble North, Manahawkin Lake, Lake Pohatcong, Holiday Lake, and Dam #113. Note that Holiday Lake Dam would only open its 6 square miles of watershed if passage is attained at Manahawkin Lake first, because it is on a tributary some distance upstream of Manahawkin Lake. Dam #113 would only open 2 square miles of watershed. Therefore, the best bets for fish passage restoration are those dams likely to open 10 square miles or more of watershed area:

Best Bets

X Double Trouble North Dam
X Manahawkin Lake Dam
X Lake Pohatcong Dam

Both Manahawkin Lake and Lake Pohatcong have already been evaluated with targeted sampling to determine the suitability of upstream habitat for anadromous fish as part of separate Early Action Reports for the feasibility study. Since the habitat upstream of Manahawkin Lake appears at this time to be unsuitable in terms of zooplankton abundance as forage for anadromous fish (although the data if for the drought year of 1999), neither it nor Holiday Lake Dam are considered best values at this time. Lake Pohatcong appears to have marginally suitable habitat for anadromous fish and is considered a best value. Also considered a best value is Double Trouble North Dam; it has the largest potential watershed area of all 11 dams, with a total of 46 square miles. The suitability of habitat (including zooplankton abundances) has not been determined for this site.

Best Values

X Double Trouble North Dam
X Lake Pohatcong Dam

Previous studies indicated the presence of alewife or blueback herring in the river below Double Trouble North Dam, Lake Pohatcong Dam, and Lake Riviera Dam (Zich 1977). Byrne

(1986) also rated several dams in the study area as potential sites for restoration of anadromous fish runs with the transfer of gravid adults upstream of five of the six groups of dams in the study area. However, Byrne (personal communication) also suggests that the naturally oligotrophic and low pH drainages in the Barnegat Bay area may result in poor food availability for anadromous fish upstream of the tidal region. Therefore, we recommend that both the best value and best bet sites received additional sampling to refine their designations. Additional studies should include sampling to determine how physical (e.g., other blockages), chemical (e.g., pH), and habitat (e.g, zooplankton) conditions affect site suitability. Future sampling is already planned for Manahawkin Lake and Lake Pohatcong.

Table 7-5. Potential fish passage restoration sites in the Barnegat Bay ecosystem. Sites above the dark line are "best bets" for restoration; shaded sites are "best value" sites.

Rank	Dam Name	STAT EID	River	Year Completed	Dam length (ft.)	Dam Height (ft. above MSL)	Maximum Discharge (CFS)	Normal Storage (acre-feet)	Surface area (acres)	Drainage area (sq. miles)	Herring Presence Zich (1977)		Byrne (1986) rating
											alewife	blueback	
1	Double Trouble North Dam	33-13	North Branch Forked River		1100	10		333	50	46	X		T
2	Manahawkin Lake Dam	33-7	Mill Creek	1929	900	12	1908	127	54	14			T
3	Lake Pohatcong Dam	32-32	Tuckerton Creek	1931	670	9	0	87	37	12		X	T
4	Holiday Lake Dam *	33-11	Fourmile Branch of Mill Creek		680	16	1192	338	39	6			S
5	New Jersey No Name # 113 Dam	29-68	Polhemus Branch	1965	100	10	650	120	25	2			
6	Deer Head Lake Dam	33-3	North Branch Forked River		660	9	0	48	32	14			S
6	Parker Street Dam	33-5	North Branch of Forked River		1100	10	1350	36	16	15			T
6	Barnegat Lake Dam	33-8	North Branch Forked River		850	18	1981	230	62	15			S
7	Rainbow Dam	29-36	Kettle Creek	1938	700	12	223	55	43	6			
7	Lake Riviera Dam	29-48	Kettle Creek		1750	11	548	37	12	6	X		T
7	Waddill Lake Dam	29-52	Kettle Creek	1963	800	12	147	200	32	3			S

Notes:
* assuming passage at Manahawkin Lake

Byrne (1986) rating:

T = potential site for establishment of anadromous fish run

S = secondary dam, upstream of one or more other dams

7.1.6 Dredged hole sites

All 24 dredged holes identified by the USACE were selected in the GIS screening phase as having restoration potential in the Barnegat Bay ecosystem. The following criteria were used to evaluate the restoration potential at these 24 sites. As with the fish passage sites, there is some uncertainty as to the habitat benefit of dredged holes of varying depths. In recent targeted studies, sampling to determine the utility of dredged holes as fish and invertebrate habitat has been undertaken at two dredged holes. The results of these studies have been incorporated into the evaluation criterion used for all sites.

Evaluation Criteria

X Depth of dredged hole (as a surrogate for combined habitat benefit to fish and invertebrates)

The evaluation of the 24 dredged holes was based on the survey data obtained by the USACE in 1998 and 1999, and on historical data dating from 1963 to 1966 (Table 7-6). The primary criterion for evaluating the sites was the depth of the hole. Based on detailed analysis of targeted sampling done in dredged holes #5 and #6 for the Early Action Report, there was a trade off between fish and invertebrate abundances that suggested filling holes to no more than 12 feet from the surface. Specifically, invertebrate abundance increased with shallower depths, while fish abundance increased from greater depths to moderate depths and then declined at the shallowest depths. Using a combined measure of habitat for both invertebrates and fish, the maximum ecological benefit appeared to be at a depth of 12 feet.

Site Selections

Because this relationship was developed from sampling in only two dredged holes, the more conservative threshold depth of 20 feet was chosen as the limit of filling almost certain to provide improved ecological benefit to both invertebrates and fish. It is also likely that filling holes less than 20 feet deep to a depth of 12 feet would provide significantly less benefit per cost of restoration. Based on this criterion, the 9 dredged holes of 20 feet or greater depth were designated as best bets.

Best Bets

X Hole 6, Harvey Cedars
X Hole 23, Toms River
X Hole 31, Metedeconk River
X Hole 18, Mantoloking Estates
X Hole 22, Manahawkin Bay
X Hole 4, Brant Beach, Long Beach Island
X Hole 3, Brant Beach, Long Beach Island
X Hole 28, Toms River
X Hole 14, Mantoloking

Rank	Location	Hole No.	Maximum Depth 1960s†	Maximum Depth 1998/99††	Acres 1960s†	Acres 1998/99	Sediment 1998/99	Historical Data 1963-1966 Date Observed	Historical Data 1963-1966 Invertebrates	Historical Data 1963-1966 DO Class *	Historical Data 1963-1966 H_2S Class **	Comments
1	Harvey Cedars	6	38	35	6	14	black	8/63	no	1	2	High resolution survey (1998)
2	Toms River	23	38	25	2	1.4	-	10/64, 1/65, 3/65	no	1	3	High resolution survey (1998)
3	Metedeconk River	31	34	24	15	-	black	9/65	no	1	3	
4	Mantoloking Estates	18	24	23	11	-	black	8/64	no	1	3	
5	Manahawkin Bay (N of Bridge)	22	34	22	25	-	black	10/64	yes	3	-	
6	Brant Beach, Long Beach Island	4	33	21	15	-	black	8/63	-	3	1	Probably in Hole 3 location, E of 4
7	Brant Beach, Long Beach Island	3	30	21	3	-	black	8/63	-	3	1	(see below, #4)
8	Toms River	28	30	21	1	1	-	9/65	no	1	3	High resolution survey (1998)
9	Mantoloking	14	24	20	9	-	black	8/64	yes	3	-	Few worms/small clams in sample
10	Head of Barnegat Bay	16	25	18	35	-	sand/shell	8/64	yes	2	1	"Good" tidal flow, not anoxic hole
11	Loveladies (N of #6)	5	23	18	4	-	black	8/63	yes	3	1	
12	Ship Bottom, Long Beach Island	37	34	17	35	-	black	10/66	yes	3	1	
13	Haven Beach, Long Beach Island	2	18	16	3	-	black	8/63	-	3	1	
14	Manahawkin Bay (Bridge)	30	28	15	18	-	black	9/65	yes	3	-	
15	Surf City	36	22	15	75	-	black	10/66	no	3	1	Elongated N-S trough
16	Silver Bay	20	30	14	8	2	black	10/64	no	1	1	High resolution survey (1998)
17	Haven Beach, Long Beach Island	1	17	14	12	-	black	8/63	-	3	1	
18	Toms River	12	17	13	10	-	black	8/63	no	2	1	
19	Toms River	29	22	10	1	1.2	-	9/65	no	1	3	High resolution survey (1998)
20	Silver Bay (W end)	21	20	10	4	-	black	10/64	no	2	1	
21	Seaside Park	10	10	10	24	-	black	8/63	yes	3	1	
22	W shore Barnegat Bay, N of Toms River	19	15	8	4	-	black	10/64	yes	3	-	
23	Toms River (S shore)	11	13	8	3	-	black	8/63	no	2	1	Few small clams in sample
24	Normandy Beach	17	24	-	5	-	-	8/64	no	3	1	Got too rough - hole not located

Notes:

† see Date Observed

†† Sorted by maximum depth

* DO Class: 1 is low dissolved oxygen, 3 is high dissolved oxygen

** H_2S Class: 1 is low hydrogen sulfide, 3 is high hydrogen sulfide

As noted above, dredged holes #5 and #6 have already been evaluated with targeted sampling to determine the extent of degraded fish and invertebrate habitat as part of the feasibility study. Using incremental analysis to determine the amount of habitat that could be created per unit of cost, dredged hole #6 was considered appropriate for restoration and hole #5 was eliminated from consideration.

In the site selection evaluation, we determined that dredged hole #6 at Harvey Cedars was the best value site based on its significantly greater depth than other holes (35 feet). Depth was used in the absence of recent sampling information on the other dredged holes. No consistent relationship between the shallower depths and historical data from single grab samples taken in 1963 to 1966 for the three relevant parameters was apparent—absence of invertebrates, low dissolved oxygen, or high hydrogen sulfide.

Best value

X Hole 6

As is the case with all best value sites selected, additional factors will need to be evaluated during feasibility before final selections are made. For the dredged holes, additional studies could include sampling to determine water quality conditions (e.g., dissolved oxygen and hydrogen sulfide levels), presence and composition of invertebrate assemblages, presence of fish, and potential for creating habitat diversity.

7.2 SUMMARY OF CANDIDATE, BEST BET, AND BEST VALUE RESTORATION SITES

The following Table 7-7 presents the numbers of sites selected for each ecosystem type within each priority category: (1) candidate sites (those identified by GIS screening, field discoveries, and resource-agent and public recommendations,); (2) best bet sites (those where we are confident of substantial restoration success); and (3) best value sites (those with especially high scores).

Table 7-7. Summary of potential restoration sites in Barnegat Bay ecosystem.

Ecosystem Type	Candidate Sites	Best Bets	Best values
Tidal and Nontidal Wetlands	52	12	6
Abandoned Lagoons	6	3	2
SAV	18	7	3
Islands for Bird Habitat	9	4	2
Fish Passage	11	3	2
Dredged Holes	24	9	1
Totals:	**120**	**38**	**16**

Figure 7-2 shows the location of all candidate restoration sites (by ecosystem type), including best bets and best values. Figure 7-3 provides the location and site number for each best bet and best value site. The remainder if this section consists of one-page descriptions providing site characterization and restoration potential information on each of the 19 best bets and best values for which field investigations were conducted (i.e., the tidal and nontidal wetlands (12), abandoned lagoons (3), and islands for bird habitat (4)). Each site description page provides a photograph and a map showing the site location. The discussion includes the site name, type of site, total score, location, size and description, restoration goal, concept for restoration action, and additional site information. The site description pages are ordered by highest score within each ecosystem category as shown in the text and tables of this report.

Figure 7-2. Location of all candidate restoration sites within the Barnegat Bay ecosystem.

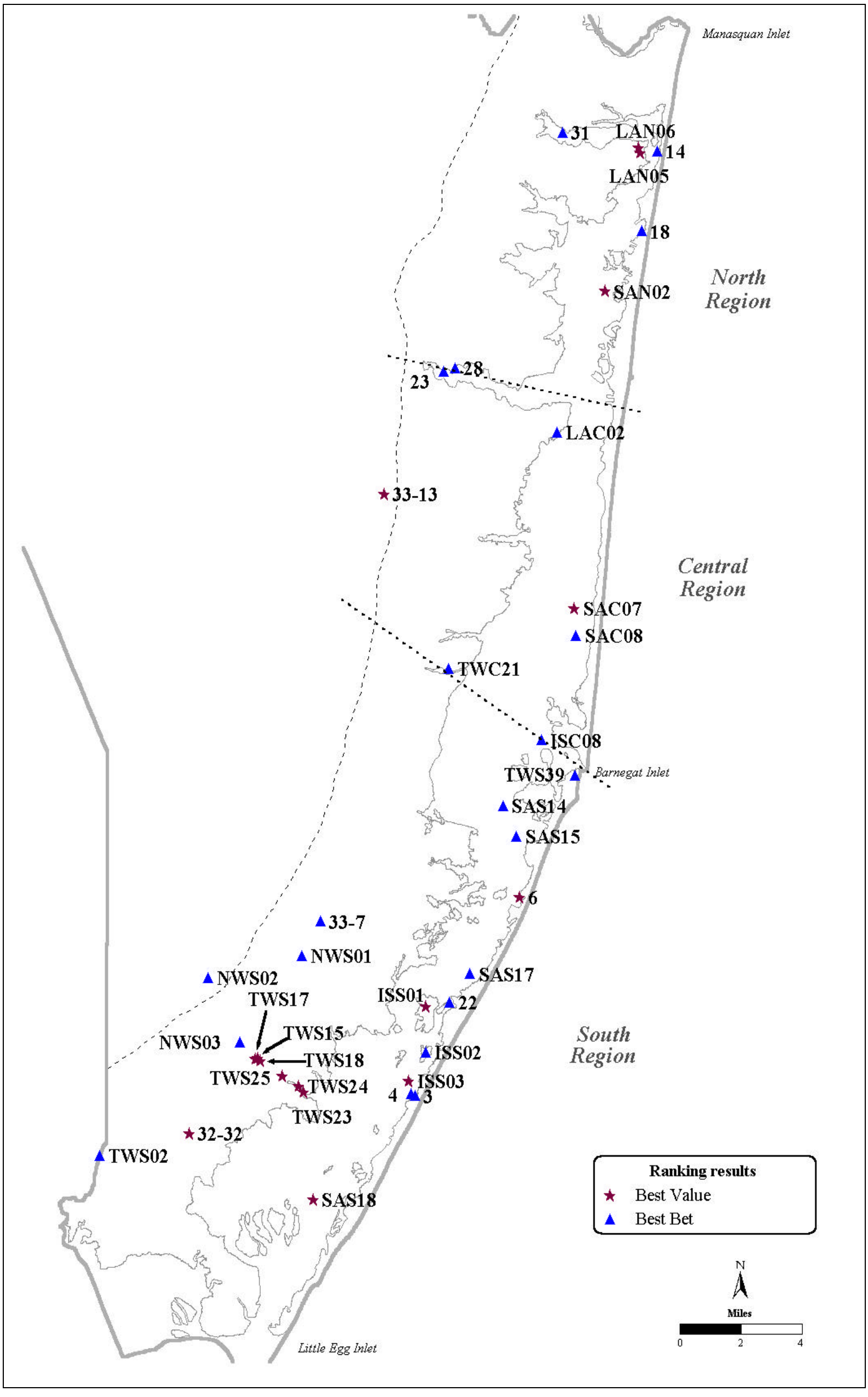


Figure 7-3. Location of all selected best bet and best buy restoration sites within the Barnegat Bay ecosystem.

Site Name: TWS15 (adjacent to TWS17 and TWS18)

Type of Site:	Tidal Wetland
Total Score:	22.4 (maximum score 27)
Location:	South of West Creek, on Westecunk Creek
Size and Description:	About 10 acres; old area of sandy, side-cast fill in tidal marsh, surrounded by phragmites
Restoration Goal:	Restore freshwater tidal marsh (a rare community); create open sandy habitats for nesting birds and diamondback terrapins

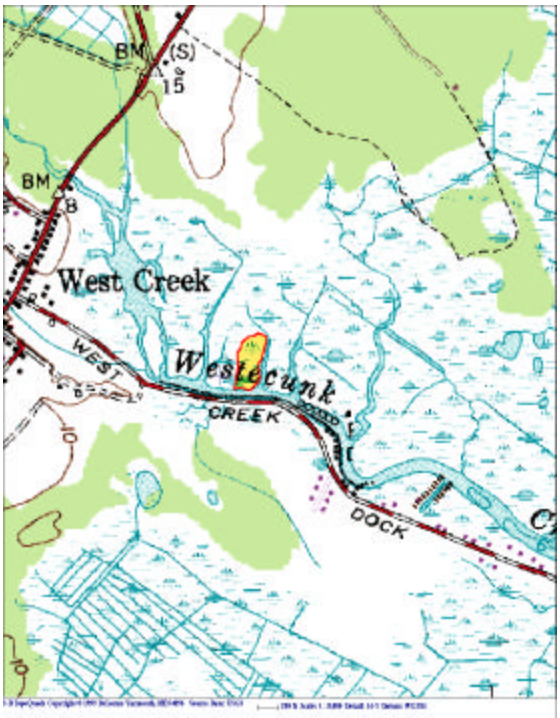
Concept for Restoration Action: This is the largest of three related sites (see TWS17 and TWS18). We propose removing or re-positioning old sandy fill from freshwater tidal marsh on Westecunk Creek. Some areas could be designed as marsh restoration; other areas could possibly be designed for use by open area-nesting birds (e.g., least tern, black skimmer) or diamondback terrapins. For the latter, the fill could be pushed to one side (with small equipment) to create open, sandy areas. Fill removed from the site could be used on other proposed projects (especially islands and dredged holes). This site is approximately 10 acres in size (fill alone is roughly 1,800 feet by 200 feet in area, and 5 to 8 feet deep). Roughly 3 or 4 acres of the site is covered by phragmites. The middle of the site is free of phragmites, the surrounding belt of phragmites is narrowest along Westecunk Creek. The phragmites could easily be treated with herbicides (although care should be taken with regard to the existing adjacent wetlands – see below).

Additional Site Information: Note that high quality freshwater tidal marsh is directly adjacent to the site, dominated by threesquare, swamp hibiscus, and other species. The freshwater marsh in this area of Westecunk Creek is relatively unditched. Because freshwater tidal marsh appears to be rare in the area, we consider this site and the two adjacent sites to have good potential for supporting rare, threatened, and endangered species. Lateral small natural creeks divide all three of these sites from each other.

Site Name: TWS17 (adjacent to TWS15 and TWS18)

Type of Site: Tidal Wetland
Total Score: 22.4 (maximum score 27)
Location: South of West Creek, on Westecunk Creek
Size and Description: About 8 acres; old area of sandy, side-cast fill in tidal marsh, surrounded by phragmites
Restoration Goal: Restore freshwater tidal marsh (a rare community); create open sandy habitats for nesting birds and diamondback terrapins

Concept for Restoration Action: This site may possess the deepest fill of three related sites. We propose removing or re-positioning old sandy fill from freshwater tidal marsh on Westecunk Creek. Some areas could be designed for use as marsh restoration; other areas could possibly be designed for open area-nesting birds (e.g., least tern, black skimmer) or diamondback terrapins. For the latter, the fill could be pushed to one side (with small equipment) to create open, sandy areas. Fill removed from the site could be used on other proposed projects (especially islands and dredged holes). This site is approximately 8 acres in size (fill alone is roughly 900 feet by 250 feet in area, and 5 to 9 feet deep). This site is also surrounded by a belt of phragmites covering roughly 3 or 4 acres of phragmites. This belt is least wide on side of Westecunk Creek; it could easily be treated with herbicides (although care should be taken with regard to the existing adjacent wetlands – see below). This site is immediately to the west of TWS15.



Additional Site Information: Note that high quality freshwater tidal marsh is directly adjacent to the site, which is dominated by threesquare, swamp hibiscus, and other species. The freshwater marsh in this area of Westecunk Creek is relatively unditched. Because freshwater tidal marsh appears to be rare in the area, we consider this site and the two adjacent sites to have good potential for supporting rare, threatened, and

endangered species. Lateral small natural creeks divide all three of these sites from each other.

Site Name: TWS18 (adjacent to TWS15 and TWS17)

Type of Site:	Tidal Wetland
Total Score:	22.4 (maximum score 27)
Location:	South of West Creek, on Westecunk Creek
Size and Description:	About 6 acres; old area of sandy, side-cast fill in tidal marsh, surrounded by phragmites
Restoration Goal:	Restore freshwater tidal marsh (a rare community); create open sandy habitats for nesting birds and diamondback terrapins

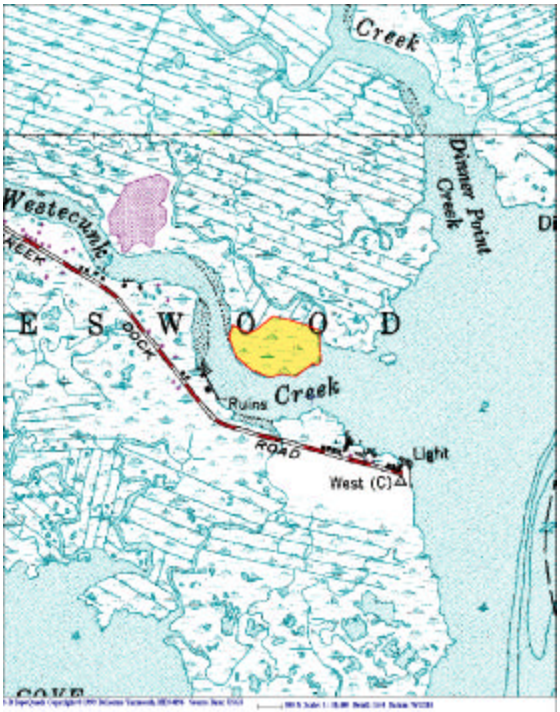
Concept for Restoration Action: This is the smallest of three related sites. We propose removing or re-positioning old sandy fill from freshwater tidal marsh on Westecunk Creek. Some areas could be designed for use as marsh restoration; other areas could possibly be designed for open area-nesting birds (e.g., least tern, black skimmer) or diamondback terrapins. For the latter, the fill could be pushed to one side (with small equipment) to create open, sandy areas. Fill removed from the site could be used on other proposed projects (especially islands and dredged holes). This site is approximately 6 acres in size (fill alone is roughly 900 feet by 125 feet in area, and 3 to 5 feet deep). This site is also surrounded by a belt of phragmites covering roughly 2 or 3 acres. The belt is least wide on side of Westecunk Creek; it could easily be treated with herbicides (although care should be taken with regard to the existing adjacent wetlands – see below). This site is immediately to the east of TWS15.

Additional Site Information: Note high quality freshwater tidal marsh directly adjacent to the site, dominated by threesquare, swamp hibiscus, and other species. The marsh in this area of Westecunk Creek is relatively unditched. Because freshwater tidal marsh seems rare in the area, we consider this site and the two adjacent sites to have good potential for rare, threatened and endangered species. Lateral small natural creeks divide all three of these sites from each other.

Site Name: TWS23 (adjacent to TWS24 and TWS25)

Type of Site: Tidal Wetland
Total Score: 20.6 (maximum score 27)
Location: South of West Creek, on Westecunk Creek (near mouth of river)
Size and Description: About 30 acres; side-cast fill in tidal marsh, covered by phragmites
Restoration Goal: Create open, sandy and tree/shrub habitats for beach-nesting birds and colonial-nesting birds

Concept for Restoration Action: This is one of three relatively close, old dredged materials disposal areas on the left bank of Westecunk Creek near its confluence with Barnegat Bay. The three sites are not as close together as TWS15, TWS17, and TWS18, and are separated by tidal marsh and several tidal waterways. This site is currently about 30 acres in size. It is primarily upland (i.e., soils do not appear saturated) and is almost entirely covered with phragmites. The phragmites could be easily treated with herbicides, but care should be taken not to spray any adjacent areas of non-phragmites marsh. Clean, sandy materials taken from sites TWS15, TWS17, and TWS18 could be deposited on these sites (after phragmites removal) to create open habitats for beach-nesting birds. Some areas could also be planted in native shrubs and trees to attract colonial nesting birds.



Additional Site Information: These three sites can be accessed only by boat. Westecunk Creek currently possesses an approximately 6-foot-deep channel throughout, and was likely dredged for a number of years. This dredging is probably the source of the side-cast fill that created these sites. Old pilings (indicating a former marina or large dock) were observed near the top of the dredged part of the creek. Some ecologically valuable freshwater tidal marsh may exist behind each of these three sites; its extent is not currently known.

Site Name: TWS24 (adjacent to TWS23 and TWS25)

Type of Site:	Tidal Wetland
Total Score:	20.6 (maximum score 27)
Location:	South of West Creek, on Westecunk Creek (near mouth of river)
Size and Description:	About 30 acres; side-cast fill in tidal marsh, covered by phragmites
Restoration Goal:	Create open, sandy and tree/shrub habitats for beach-nesting birds and colonial-nesting birds

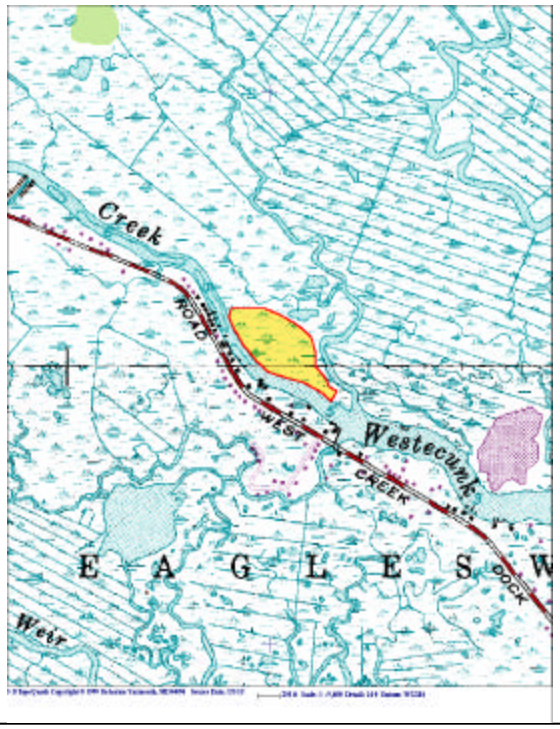
Concept for Restoration Action: This is one of three relatively close, old dredged material disposal areas on the left bank of Westecunk Creek near its confluence with Barnegat Bay. The three sites are not as close together as TWS15, TWS17, and TWS18, and are separated by tidal marsh and several tidal waterways. This site is estimated to be about 30 acres in size. It is primarily upland (i.e., soils do not appear saturated) and is almost entirely covered with phragmites. The phragmites could be easily treated with herbicides, but care should be taken not to spray adjacent areas of non-phragmites marsh. Clean, sandy materials taken from sites TWS15, TWS17, and TWS18 and deposited on these sites (after phragmites removal) could create open habitats for beach-nesting birds. Some areas could also be planted in native shrubs and trees to attract colonial nesting birds.

Additional Site Information: These three sites can be accessed only by boat. Westecunk Creek currently possesses an approximately 6-foot-deep channel throughout, and was likely dredged for a number of years. This dredging is probably the source of the side-cast fill that created these sites. Old pilings (indicating a former marina or large dock) were observed near the top of the dredged part of the creek. Some ecologically valuable freshwater tidal marsh may exist behind each of these three sites; its extent is not currently known.

Site Name: TWS25 (adjacent to TWS23 and TWS24)

Type of Site: Tidal Wetland
Total Score: 20.6 (maximum score 27)
Location: South of West Creek, on Westecunk Creek (near mouth of river)
Size and Description: About 20 acres; side-cast fill in tidal marsh, covered by phragmites
Restoration Goal: Create open, sandy and tree/shrub habitats for beach-nesting birds and colonial-nesting birds

Concept for Restoration Action: This is one of three relatively close, old dredged material disposal areas on the left bank of Westecunk Creek near its confluence with Barnegat Bay. The three sites are not as close together as TWS15, TWS17, and TWS18, and are separated by tidal marsh and several tidal waterways. This site is apparently the smallest of the three, and is estimated to be 20 acres in size. It appears to have a few saturated areas, but appears to be almost all upland, and is almost entirely covered with phragmites. The phragmites could readily be treated with herbicides, but care should be taken not to spray adjacent areas of non-phragmites marsh. Clean, sandy materials taken from sites TWS15, TWS17, and TWS18 and deposited on these sites (after phragmites removal) could be used to create open habitats for beach-nesting birds. Some areas could also be planted in native shrubs and trees to attract colonial nesting birds.

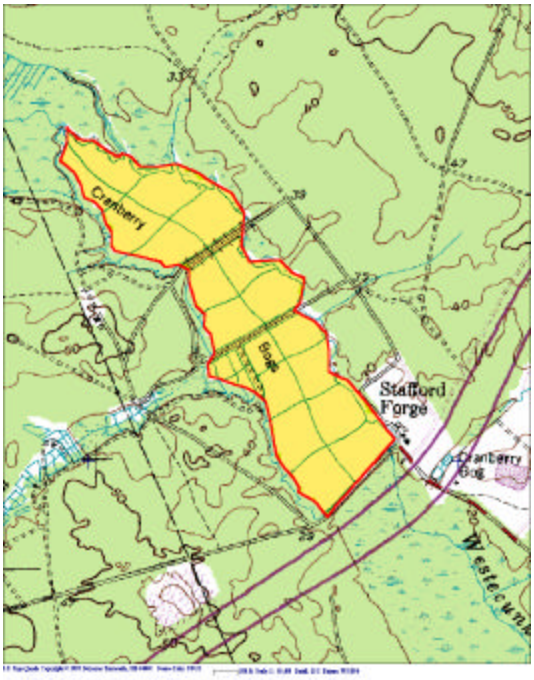


Additional Site Information: These three sites can be accessed only by boat. Westecunk Creek currently possesses an approximately 6-foot-deep channel throughout, and was likely dredged for a number of years. This dredging is probably the source of the side-cast fill that created these sites. Old pilings (indicating a former marina or large dock) were observed near the top of the dredged part of the creek. Some ecologically valuable freshwater tidal marsh may exist behind each of these three sites; its extent is not currently known.

Site Name: NWS02 (Stafford Forge WMA)

Type of Site:	Nontidal Wetland
Total Score:	18.9 (maximum score 27)
Location:	North of West Creek, immediately north of Garden State Parkway
Size and Description:	About 50 acres; series of large open water ponds (former cranberry bogs), managed by NJDEP as a wildlife management area
Restoration Goal:	Restore Atlantic white cedar wetlands and anadromous fishery to Westecunk Creek

Concept for Restoration Action: We propose removing water control structures and berms from several large open-water ponds for restoration of historic Atlantic white cedar wetlands (some extensive cedar stands currently exist at the WMA), restoration of upstream passage for anadromous fish, and restoration of Westecunk Creek to its natural channel, where appropriate. There are three very large main ponds and several smaller ponds; the whole area of concern is roughly 50 acres. The project could potentially open several miles of upstream habitat for anadromous fish.

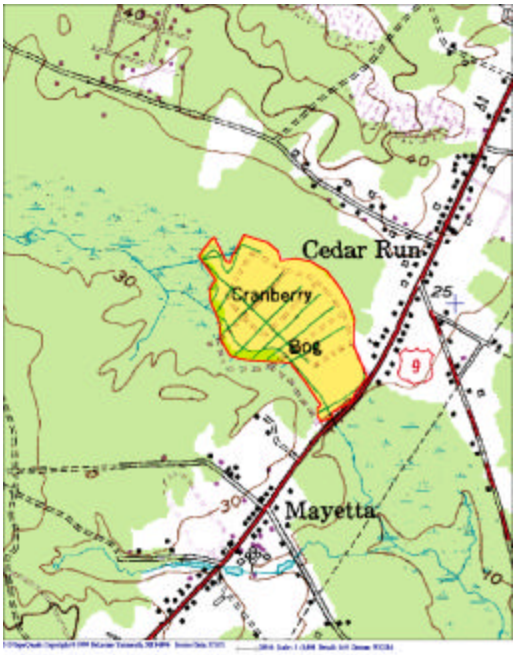


Additional Site Information: It is not currently clear how NJDEP plans to manage this site and whether the project would be consistent with current management. It is likely technically possible to open up the creek up to fish passage and still maintain some of the smaller lateral ponds for other wildlife uses. Existing hydrology must be investigated in the feasibility study for this site. There are several existing water control structures present; the principal one is located at the southern-most end of the southern pond (the other structures are minor). It is estimated that there is an approximately 5 to 6 foot drop from this structure to the stream. Note that this project should be done in conjunction with site NWS03 (removal of a small, old, cranberry bog structure about 2 miles downstream from Stafford Forge WMA), where there is a minor fish blockage. Aside from NWS03, we found no other potential fish blockages on Westecunk Creek in the area above or below Stafford Forge WMA.

Site Name: NWS01 (Cedar Run abandoned cranberry bog)

Type of Site:	Nontidal Wetland
Total Score:	18.6 (maximum score 27)
Location:	0.5 mile south of Rt. 72/Rt. 9 interchange (south of Manahawkin, immediately west of Rt. 9)
Size and Description:	About 25 acres; series of open water ponds (former cranberry bogs), owned by USFWS
Restoration Goal:	Restore Atlantic white cedar wetlands and anadromous fishery to Cedar Creek

Concept for Restoration Action: We propose removing a dilapidated water control structure and three partially breached berms from this former cranberry bog area to restore upstream passage for anadromous fish, and a historic Atlantic white cedar wetland (some cedar stands currently exist on site). The three existing dikes are fairly insubstantial and eroded; they each measure roughly 15 feet wide by 200 feet long and are made of sand. We propose restoring Cedar Creek to its natural channel where appropriate. There are two main ponds divided by the partially-breached dikes; the total site area is roughly 25 acres. The project could potentially open several miles of upstream habitat for anadromous fish.



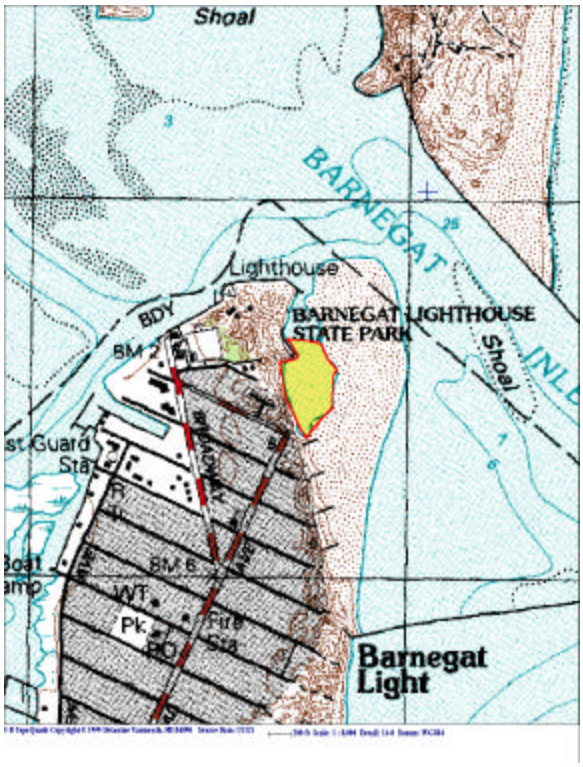
Additional Site Information: USFWS indicated during the reconnaissance field visit that they would support restoration actions at this site. The existing water control structure is relatively small (concrete with boards) and could probably be easily removed. It was estimated that there is a three-foot drop between the structure and the stream. Existing hydrology as well as upstream habitat suitability must be investigated in the feasibility study for this site. We observed no other potential fish blockages on Cedar Creek above or below this site. This site possesses some fairly nice adjacent Atlantic white cedar wetlands to the north/northwest, presumably the site could be recolonized once appropriate hydrology is restored.

Site Name: TWS39 (Barnegat Light south)

Type of Site: Tidal Wetland
Total Score: 17.7 (maximum score 27)
Location: Immediately south of Barnegat Inlet, along beach
Size and Description: Large area of phragmites along back dune of beach
Restoration Goal: Restore large area of open sand habitat for beach-nesting birds

Concept for Restoration Action: We propose removing a large area of phragmites, beach grass, and other herbaceous vegetation from an approximately 20-acre parcel of back dune. The action would help to restore habitat for beach-nesting birds (most notably piping plover). The phragmites may have been established in a wet area of the site (it shows up as a dark, potentially wet area on 1995 aerial photos). It might be appropriate to place new sandy materials in this area, if not throughout the site (to slow recolonization of the phragmites).

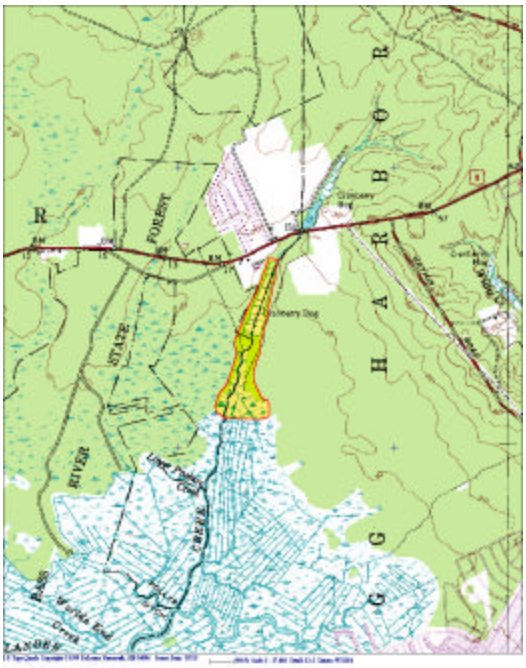
Additional Site Information: More research needs to be done during feasibility to determine if this site needs new sandy fill, or whether restoration should be limited to phragmites/vegetation removal. Additional site stabilization, such as geotubing or snow fencing, should be considered. Successful and appropriate restoration could provide a site attractive to piping plovers (a Federally listed endangered species). The site was suggested by Bob DeLeonard of the NJ Beach Buggy Association, who indicated a great interest in the project.



Site Name: TWS02 (Ballanger Creek abandoned cranberry bog)

Type of Site: Tidal Wetland
Total Score: 16.7 (maximum score 27)
Location: About 2 miles southwest of Tuckerton, off Route 9 (south side)
Size and Description: About 25 acres; former cranberry bog pond, owned by NJDEP
Restoration Goal: Restore Atlantic white cedar wetlands and enhance rare, threatened and endangered species habitat

Concept for Restoration Action: We propose removing a partially dilapidated water control structure and an earthen dike (approximately12 feet wide by 10 feet tall by 200 feet long) from a former cranberry bog area to restore historic Atlantic white cedar wetlands (some cedar stands currently exist on the site) and promote existing rare, threatened, and endangered species (at least three of the species of concern swamp pink, bog asphodel, and Pine Barrens tree frog, are strongly associated with Atlantic white cedar wetlands). We propose restoring Ballanger Creek to its natural channel where appropriate and removing an area of dense phragmites below the existing pond (see photograph). There is only one pond on the site; the whole area of concern is roughly 25 acres, including the area of phragmites below the pond.

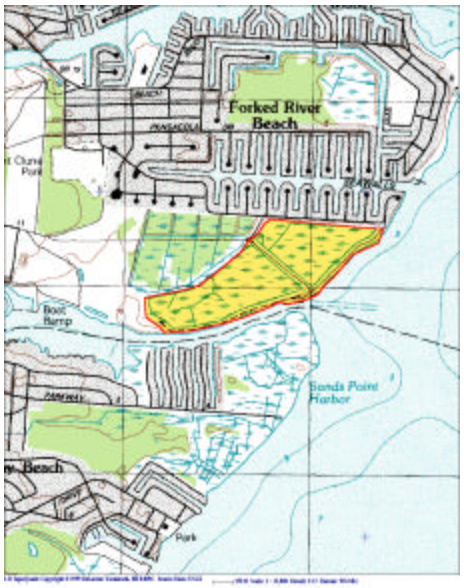


Additional Site Information: According to information from the NJDEP Heritage group, this site is part of a NJDEP Natural Heritage area that contains several rare flora and fauna. At present, we do not know which species are present or what plans NJDEP has to manage them. Nonetheless, there is a definite opportunity at the site to drain the artificial cranberry bog pond, restore the natural flow of the stream, and reestablish Atlantic white cedar wetlands. There is limited opportunity for reestablishing anadromous fish runs at this location; another bog/pond (presumably with a water control structure) exists immediately west (on the other side) of Route 9.

Site Name: TWC21 (Oyster Creek dredged materials disposal site)

Type of Site: Tidal Wetland
Total Score: 16.1 (maximum score 27)
Location: Left bank of Oyster Creek, at mouth (confluence with Bay)
Size and Description: About 200 acres; dredged material disposal site (may not be active)
Restoration Goal: Restore and create open, sandy and tree/shrub habitats for beach-nesting birds and colonial-nesting birds

Concept for Restoration Action: This is a fairly old dredged material disposal area (we estimated about 200 acres total) on the left bank of Oyster Creek, near its confluence with Barnegat Bay. The site is in a good location to attract beach-nesting and tree-nesting birds (given appropriate restoration of habitat) as well as diamondback terrapins. The site currently consists of a large open sandy area, uplands dominated by weak phragmites and switchgrass, and wetlands dominated by dense phragmites and highbush blueberry. At a minimum, the large open existing sandy area (about 15 acres) should be improved by removing vegetation and expanding into current upland phragmites areas. It would also be desirable to remove at least some of the phragmites from the existing wetlands areas. Clean, sandy materials taken from nearby linked sites or from dredging projects could be deposited on the site (after phragmites removal) to create open habitats for beach-nesting birds and diamondback terrapins. Some areas of the site could also be planted in native shrubs and trees to attract tree-nesting birds such as herons.

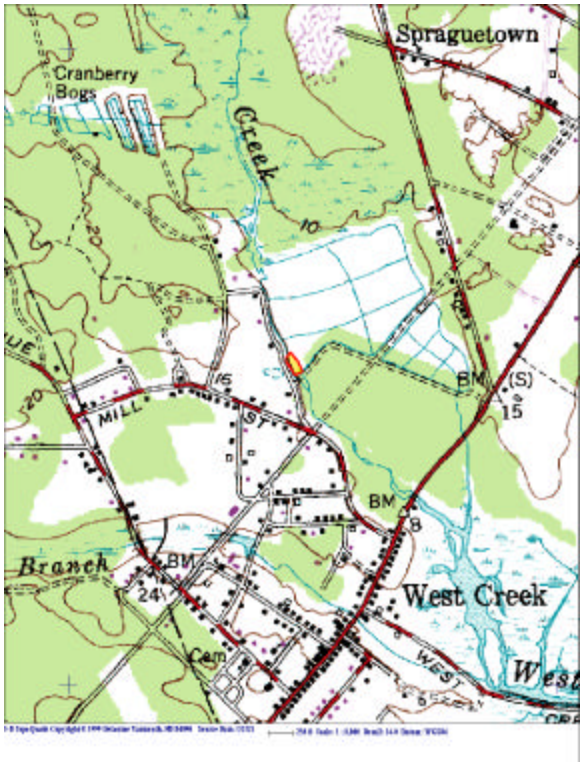


Additional Site Information: This is a sizeable site, with an apparent large potential for improvement. It should be noted that David Jenkins of NJDEP Wildlife also recommended this site at the first public workshop as being a good one for restoration of beach-nesting bird habitat (because of its location near the mouth the creek). The long-term goals for dredged material disposal at this site are not presently clear (i.e., is restoration feasible here if the site will be used again within 10 years). We observed a number of what appeared to be diamondback terrapin scrapes with eggshells in the open sandy area of the site. Restoration efforts could focus on improving existing habitats to make them more suitable for this species as well. Signs of predators (primarily raccoons) were noted in several areas of the site. Long-term predator removal would probably be necessary as part of the restoration.

Site Name: NWS03 (Silver Lake small structure removal)

Type of Site: Nontidal Wetland
Total Score: 15.7 (maximum score 27)
Location: Silver Lake area of West Creek , immediately north of Route 9
Size and Description: Old concrete cranberry bog structure (fish blockage)
Restoration Goal: Reestablish anadromous fishery to Westecunk Creek

Concept for Restoration Action: This project would involve removal of an approximately 100-year-old water control/diversion structure on Westecunk Creek. Removal of this structure and the structures at Stafford Forge WMA (refer to NWS02) is believed to be critical for restoration of an anadromous fishery to Westecunk Creek (Stafford Forge is about two miles upstream of this site). The structure consists of four concrete slabs about 10 feet by 10 feet by 1.5 feet held together by small steel rails, and a 10-foot by 10-foot by 12-foot earthen berm.



Additional Site Information: The resident who lives across the street claims that she owns the access to the structure, so we have considered this to be private property (even though the structure itself is sitting in the stream). The woman raises ducks in pens adjacent to her house and apparently uses a quiet downstream area on the diversion channel to train the ducks how to swim. She seemed quite open to removal of the concrete structure as long as it would not affect her duck operation (mitigation may be necessary). She is a long-time resident, and provided a good deal of anecdotal information regarding anadromous fish (striped bass, shad, etc.) that people have caught/observed downstream of this site. We should contact this property owner to gain access to the site and to obtain additional information.

Site Name: LAN05 (near LAN06)

Type of Site: Abandoned lagoon
Total Score: 16.8 (maximum score 27)
Location: West Mantoloking, north side of Route 528, before bridge to LBI
Size and Description: About 10 acres; abandoned lagoon (southern one of two nearby sites), within Forsythe NWR
Restoration Goal: Reestablish tidal marsh; create isolated ponds; improve upland habitats

Concept for Restoration Action: This site is the southernmost of two unconnected abandoned lagoons within the Forsythe NWR (posted). The main channel of this lagoon (roughly an "F" shape in profile) is about 1,200 feet long and 125 feet wide, with two branches of similar length about 60 feet wide). We noted tall piles of excavated materials on both sides of the lagoon. The lagoon is bordered by good quality tidal marsh to the west; restoration actions should interface with these habitats. This project should combine restoration of tidal marsh, upland habitat improvements, creation of semi-isolated ponds, and other elements. Some areas of the mounded materials could be pushed back into the water and then replanted for reestablishment of tidal marsh. These areas should be hydrologically connected to the existing marsh. A small amount (a few acres) of phragmites currently exists on the upland areas, and should be removed. Upland habitats should be improved by removing phragmites and planting native trees and shrubs. This presents an excellent opportunity to establish open, sandy habitats for beach-nesting birds and diamondback terrapins.

Additional Site Notes: This lagoon appears to possess a sandy, uniform bottom with a depth of roughly 5 to 6 feet. It is not clear at this time whether boat access is possible. A few ducks were observed at this site during the field visit, but there were many more using the high-quality back marshes immediately to the west. The shape of this lagoon provides more existing upland habitats than at LAN06, because of the shape of this lagoon.

Site Name: LAN06 (near LAN05)

Type of Site: Abandoned lagoon
Total Score: 16.8 (maximum score 27)
Location: West Mantoloking, north side of Route 528, before bridge to LBI
Size and Description: About 8 acres; abandoned lagoon (northern one of two nearby sites), within Forsythe NWR
Restoration Goal: Reestablish tidal marsh; create isolated ponds; improve upland habitats

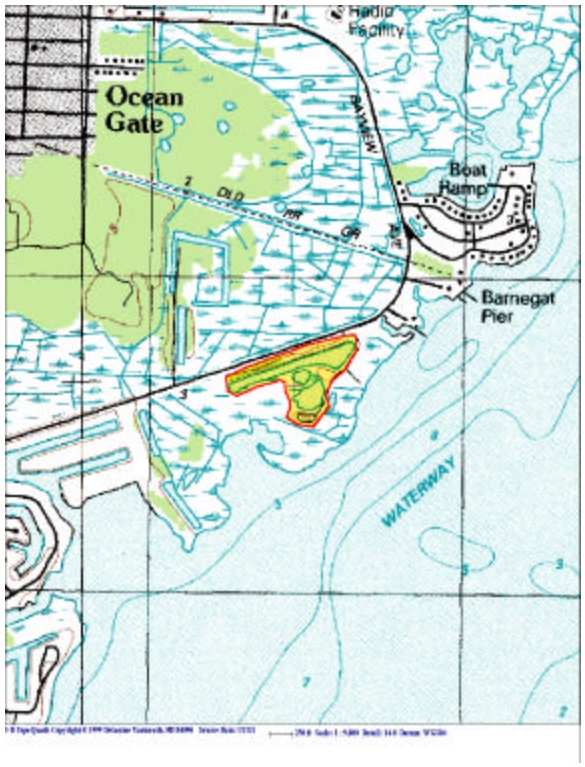
Concept for Restoration Action: The site is the northernmost of two unconnected abandoned lagoons within the Forsythe NWR (posted). The main channel of this lagoon (roughly an "L" shape in profile) is about 900 feet long and 125 feet wide. We noted tall piles of excavated materials on both sides of the lagoon. The lagoon is bordered by good quality tidal marsh on the west side; restoration actions should interface with these habitats. This project should combine restoration of tidal marsh, upland habitat improvements, creation of semi-isolated ponds, and other elements. Some areas of the mounded materials could be pushed back into the water and then replanted for reestablishment of tidal marsh. These areas should be hydrologically connected to the existing marsh. A small amount of phragmites (about two acres) currently exists on the upland areas, and should be removed. Upland habitats should be improved by removing phragmites and planting native trees and shrubs.

Additional Site Information: This lagoon appears to possess a sandy, uniform bottom with a depth of roughly 5 to 6 feet. It is not clear at this time whether boat access is possible. A few ducks were observed at this site during the field visit, but there were many more using the high-quality back marshes immediately to the west. Because of the shape of this lagoon, fewer upland habitats exist at this site than at LAN05.

Site Name: LAC02 (Bayville Lagoon; see also LAC03)

Type of Site: Abandoned lagoon
Total Score: 15.8 (maximum score 27)
Location: Off Bayview Avenue (south of road), near Ocean Gate community
Size and Description: About 6 acres; abandoned lagoon (southern one of two nearby sites)
Restoration Goal: Reestablish tidal marsh; create isolated ponds; improve upland habitats

Concept for Restoration Action: This site could most benefit from fill removal (including removal of the existing dirt/sand access road) and marsh reestablishment. It is approximately 1,200 feet long, 125 feet wide, and 6 feet deep, and possesses a relatively flat, uniform sandy bottom. The adjacent marsh is frequently used by local hunters and fishermen; the tidal marsh adjacent to the site appears to be of good quality. Some of the mounded materials and road fill could be used for reestablishment of tidal marsh. These areas should be hydrologically connected to the existing marsh. Upland habitats should be improved by removing phragmites and planting native trees and shrubs. Paths and boardwalks could be established here to encourage public use (removal of the road would also help prevent illegal dumping).

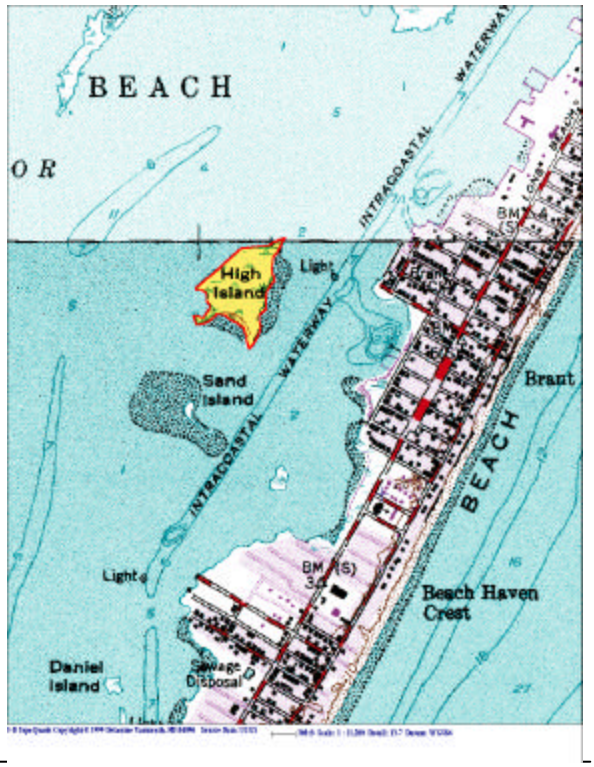


Additional Site Information: The property is posted as owned by Ocean County Land Trust. Illegal dumping at this site is common. The lagoon edge has been cut, but no bulkheading is present. Duck blinds were present where the site meets the Bay (indicating use of the area by hunters); several fishermen were observed during the field studies. It is not clear whether boat access is possible.

Site Name: ISS03 (High Island)

Type of Site: Island for restoration of bird habitat
Total Score: 17.0 (maximum score 24)
Location: Directly west of Brant Beach, LBI
Size and Description: About 15 acres; dredged material disposal island
Restoration Goal: Create open, sandy habitats for beach-nesting birds

Concept for Restoration Action: We propose removing phragmites and other herbaceous vegetation from former dredged materials disposal island; the site is approximately 15 acres. The phragmites should be treated several times with herbicides for successful removal. About 2 to 3 feet of new, clean sandy materials should be added over the entire upland portion of the island to provide suitable substrate for beach-nesting birds (e.g., black skimmer, least tern). Some method of containing new sandy materials should be employed (e.g., snow fencing, silt curtains, biologs) to hold the sand on the island and protect existing SAV. There were relatively few shrubs or trees present on this site. The site is relatively flat. Some areas of tidal wetlands exist along the southern end of the island; these areas should be avoided during phragmites removal and the placement of new material.



Additional Site Information: Because there are relatively few shrubs and trees on this island, it is probably most appropriate to restore it as open, sandy habitat for beach-nesting birds (as opposed to planting trees for tree-nesting birds such as herons and egrets). No evidence of predators was noted during the field studies (e.g., direct observation, scats, tracks). Boat access to the site was good from the east side. Some areas of SAV were observed on the east side of the island.

Site Name: ISS01 (Cedar Bonnet Island)

Type of Site:	Island for restoration of bird habitat
Total Score:	16.9 (maximum score 24)
Location:	Immediately south of Route 72 bridge, about 0.5 mile west of Ship Bottom
Size and Description:	About 60 acres; dredged materials disposal island
Restoration Goal:	Create open, sandy and tree/shrub habitats for beach-nesting birds and tree-nesting birds

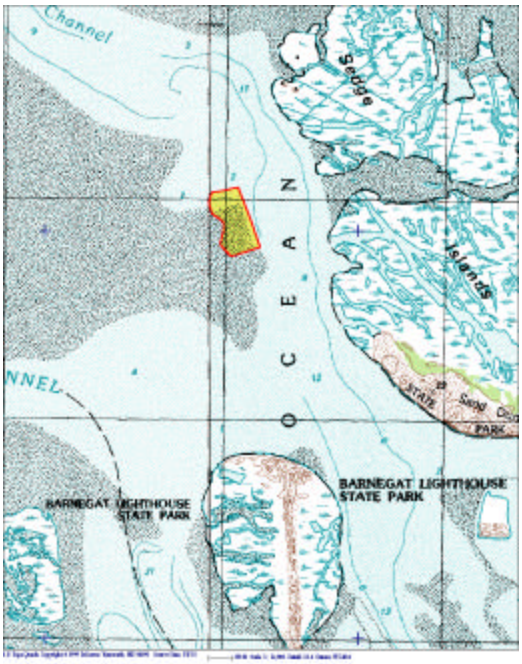
Concept for Restoration Action: We propose removing phragmites and other herbaceous vegetation from a former dredged materials disposal island; the site is approximately 100 acres. The phragmites should be treated several times with herbicides for successful removal. About 2 to 3 feet of new, clean sandy materials should be added where appropriate to provide suitable substrate for beach-nesting birds (e.g., black skimmer, least tern) and diamondback terrapins. The site is relatively flat, with few high spots. There were small areas of shrubs and trees present on the highest elevations of this site; these areas should be preserved and protected for tree-nesting birds and other wildlife. The largest existing woody plants observed during the field studies were bayberry shrubs. Other deciduous trees, shrubs, and woody vines observed during the field studies included cottonwood, red maple, crack willow, and poison ivy. Some areas of tidal wetlands exist in the vicinity and are considered part of the island, but these are not connected to the part being considered for restoration. Some method of containing the new sandy materials should be employed (e.g., snow fencing, silt curtains, biologs) to hold the sand on the island (and protect existing SAV).

Additional Site Information: Despite the thickness of the phragmites and other vegetation on most areas of the site, diamondback terrapin scrapes and egg shells were observed on several open, sandy areas (particularly at the site's highest point). Amenities for this species should be incorporated into restoration of this site, if possible. Because the island is connected to the mainland by the Route 72 bridge, it may be appropriate to incorporate permanent predator deterrents/exclusion into the design of the restoration, such as moats and tidal channels. Additionally, the site's location and apparent high usage may necessitate the incorporation of amenities for the public, such as footpaths, trails, and bridges into any restoration designs. This site is owned by the USFWS.

Site Name: ISS08 (Island #26A)

Type of Site: Island for restoration of bird habitat
Total Score: 16.1 (maximum score 24)
Location: About 1.5 miles northwest of Barnegat Lighthouse
Size and Description: About 5 acres; dredged materials disposal island
Restoration Goal: Create open, sandy and for beach-nesting birds

Concept for Restoration Action: We propose removing phragmites and other herbaceous vegetation from a former dredged materials disposal island; the site is approximately 5 acres. The island was last used about four years ago for dredged material disposal, and is currently being colonized by phragmites, switchgrass, and other herbaceous vegetation. About 2 to 3 feet of new, clean sandy materials should be added (more may be required in some areas) to provide suitable substrate for beach-nesting birds (e.g., black skimmer, least tern) and diamondback terrapins. Areas of "dips" should be filled in for the flatter, more level, sandy surface preferred by beach-nesting birds. Some method of containing new sandy materials should also be employed (i.e., snow fencing, silt curtains, biologs) to hold the sand on the island and protect existing SAV.



Additional Site Information: According to David Jenkins, NJDEP Wildlife, the island was used for several years after the last disposal operation by a large number of black skimmers and other beach-nesting birds. As the vegetation began to recolonize the site, fewer of these species used the island. Opportunistic birds, particularly herring gulls (apparently overabundant in the area), now heavily use the island and preclude its use by the open beach-nesting species. Removing vegetation from the island would help to reestablish the black skimmers, terns, and other beach-nesting birds. It should also be noted that the heavy shoaling and sandbars around the north and west sides of the island make navigation to the island difficult; the site was accessed by anchoring the boat a distance away at low tide and walking to shore wearing chest waders.

Site Name: ISS02 (Flat Island)

Type of Site: Island for restoration of bird habitat
Total Score: 16.0 (maximum score 24)
Location: About 1 mile south and west of Ship Bottom, LBI
Size and Description: About 30 acres; dredged materials disposal island
Restoration Goal: Create open, sandy and tree/shrub habitats for beach-nesting birds and colonial-nesting birds

Concept for Restoration Action: We propose removing phragmites and other herbaceous vegetation from a former dredged materials disposal island; the site is approximately 30 acres. The vast majority of the island vegetation is currently phragmites. The phragmites should be treated several times with herbicides for successful removal. About 2 to 3 feet of new, clean sandy materials should be added to provide suitable substrate for beach-nesting birds (e.g., black skimmer, least tern) or diamondback terrapins. Some method of containing new sandy materials should be employed (i.e., snow fencing, silt curtains, biologs) to hold the sand on the island and protect existing SAV. The site is very flat. Small areas of shrubs and trees were present on the highest areas of the site. A total of five old heron or egret nests (colonial tree-nesting birds) were present in some bayberry shrubs and high tide bushes during the field studies (it is not known when the island was last used by the birds). Feasibility studies must determine what areas of existing trees and shrubs should be preserved and protected for tree-nesting birds and other wildlife.

Additional Site Information: The northwestern part of the island appeared to have been most recently used for dredged materials disposal. Narrow areas of tidal marsh were observed on the northern and southern ends of the island; these should be protected from phragmites removal and new materials deposition. Several man-made wooden structures were observed during the field investigation; they appeared to be used for shading plants or nests. As part of feasibility studies for restoration at the island, contacts should be made to determine if the structures are still in use.

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APPENDIX A

BARNEGAT BAY ECOSYSTEM RESTORATION SITE SELECTION – WORKSHOP AND MEETING MINUTES

Morris Perot, Mark Southerland, and Steve Harriott
Versar, Inc.
March 31, 2000

Barnegat Bay Ecosystem Restoration Site Selection – Workshop and Meeting Minutes

Introduction

On November 15, 1999, the U.S. Army Corps of Engineers (USACE), Philadelphia District initiated the delivery order to Versar, Inc. for the Barnegat Bay GIS Restoration Site Selection Project. This project is an integral component of the feasibility study being undertaken by the District pursuant to the 1995 Congressional resolution to identify possible improvements in ecosystem restoration and protection. The New Jersey Department of Environmental Protection (NJDEP) is the designated non-Federal sponsor. The goal of this project is to identify and obtain more specific information on the geographic locations of high-priority restoration sites. This project builds on the GIS evaluation and planning study recently completed by Versar, the GIS database task currently underway at Versar, and other activities of the District.

The following is a summary of four workshops and meetings held to gather public and expert input to support site selection. Each workshop and meeting included a presentation by the project team followed by informal discussions. These minutes include workshop and meeting objectives, presentation materials (Appendix 1), workshop and meeting results including recommended restoration sites (Appendix 2) and supporting materials (Appendix 3), and lists of attendees (Appendix 4). The following workshops and meetings were held:

- Public workshop in Lacey Branch of Ocean County Library, Forked River, NJ on January 24, 2000
- Meeting with Barnegat Bay Estuary Program Management Committee in Toms River, NJ on February 15, 2000
- Public workshop in Ocean County Library, Toms River, NJ on February 23, 2000
- Meeting with Barnegat Bay Estuary Program Management Committee in Toms River, NJ on March 21, 2000

Public Workshop (January 24, 2000) – Lacey Branch Library, Forked River, NJ

Objective

The objective of this workshop was to provide the general public with a brief introduction to the site selection project and solicit input on recommended restoration sites. The format included a brief presentation followed by workgroup breakout sessions for residents, resource agency personnel, and the press to look at maps of the study area, fill out project suggestion cards, and talk with the project team about potential restoration projects in the Barnegat Bay ecosystem. The workshop was held from 4 to 6 p.m. and was repeated from 7 to 9 p.m.

Participants

A total of 37 individuals joined the project team members for this workshop (Appendix 4). Participants included state and local agency representatives, special interest groups, and private citizens.

Workshop Results

Terry Fowler, project manager for the USACE, began the public workshop by introducing herself and the project team. After stating the objective for the meeting, she turned the floor over to Mark Southerland of Versar, Inc. for the presentation (Appendix 1). Following the presentation, Dr. Southerland asked the audience to join one of the three map stations staffed by project personnel from Versar and the USACE to discuss and identify potential restoration opportunities. The audience was asked to locate recommended sites and fill out suggestion cards describing their ideas. The list of the 25 suggested projects and a brief description of public comments is included in Appendix 2. Additional materials on specific sites submitted after the meeting are included in Appendix 3.

Barnegat Bay Estuary Program Management Committee Meeting (February 15, 2000) – Ocean County One-Stop Center, Toms River, NJ

Objective

The objective of this meeting was to introduce the Barnegat Bay Estuary Program (BBEP) Management Committee to the site selection project and solicit input on recommended restoration sites. The same presentation used in the January public workshop was made to initiate discussions. The meeting was held at the end of the Management Committee agenda.

Participants

A total of 10 members (or cooperators) of the BBEP Management Committee (Appendix 4) witnessed the presentation and participated in the discussion. Dave McKeon of Ocean County Planning and Ed Henry of U.S. Fish and Wildlife Service left before the presentation, but were contacted the following day and their comments solicited.

Meeting Results

Ms. Fowler answered 20 minutes of questions from the Committee about the USACE's Dredged Holes and Fish Ladders EAR\EA projects; she clarified that the site selection was a separate project. Dr. Southerland then repeated his talk from the January 24th Public Workshop. He informed the Committee that the presentation had been developed for the general public and where appropriate skimmed over background information. After the presentation, Dr. Southerland and Ms. Fowler solicited comments and project suggestions from the remaining Committee members. Two project locations involving bird habitat and phragmites removal in

Little Egg Harbor were suggested by Angela Anderson of the American Littoral Society (Appendix 2). The recreational fishing representative, Tom Fote, indicated that he would provide site recommendations by email. Bob Dieterich of EPA Region II indicated that he supported the islands and wetlands restoration ideas. In telephone contacts, Dave McKeon stated that no specific sites came out of his County Planning Board meeting; likewise, Ed Henry had no new sites to add.

Progress Report Workshop (February 23, 2000) – Ocean County Library, Toms River, NJ

Objective

The objective of this workshop was to update the general public on the progress since the first public workshop and to present preliminary results. The presentation contained enough detail to inform the audience on the site selection process and demonstrate that their input was being considered. The workshop was held from 4 to 6 p.m. and was repeated from 7 to 9 p.m.

Participants

A total of 11 individuals joined the project team members for this meeting (Appendix 4). Participants included State and local agency representatives, special interest groups, and private citizens.

Workshop Results

Ms. Fowler discussed the workshop format and schedule, and introduced the project team prior to Dr. Southerland's presentation. Following each presentation, questions and comments were solicited from the meeting participants.

<u>4 p.m. – 6 p.m. Session</u>

The commercial shellfishing representative, Gef Flimlin, asked if the site selection project considered shellfisheries when selecting sites because bay scallops are not present and hard clams are very scarce in the bay even though they used to be commercial resources. Ms. Fowler stated that the scope of the project is focused on specific sites, not the lack of shellfish in the Bay, because specific sites and causes have not been identified. She mentioned that it might be more appropriate for the BBEP to respond to this question.

Tom Fote, recreational anglers' representative, stated that the USACE's past history has resulted in skepticism over the ulterior motives behind this project, and that the USACE should have met with anglers at the outset of the Barnegat Bay Ecosystem Restoration Feasibility Study. He did recognize that this was prior to Ms. Fowler joining the USACE.

Joan Koons stated that people should look forward towards the good that can come from the project, not at historical actions taken by the USACE or others. This project presents

opportunities for forming partnerships that encourage stakeholders to work together. She specifically encouraged the USACE to enlist community organizations and volunteers in their restoration efforts. Ms. Koons also suggested the dredging of Beach Haven Inlet to promote better flushing in Little Egg Harbor.

Larry Savadove , a reporter from The Sandpaper, asked how much money will be spent on restoration. Ms. Fowler stated that it depends on several factors. Once the sites have been selected, restoration costs will be calculated. Once this is done, the USACE and the non-Federal sponsor NJDEP will need to gather funding, a process which is dependent on the authorization of their budgets by Federal and State legislators.

Gef Flimlin and Peter McCarthy mentioned that they had sent an email to Ms. Fowler concerning an observation that eelgrass has became established in a Virginia company's clam aquaculture bed in the Chesapeake Bay. These gentlemen suggested that if aquaculture promotes SAV growth, perhaps aquaculture could be a viable way to restore both SAV and clams in Barnegat Bay. Mr. Flimlin suggested that the USACE, because of this project and their Nationwide Permit #4 banning aquaculture in SAV, work with shellfishermen so that aquaculturists may obtain a lease and conduct a pilot test to see if this association is true.

Jerome Walnut asked that the USACE work with the towns and communities in the vicinity of the projects. Mr. Walnut specifically mentioned projects near Barnegat Light involving the removal of phragmites, and requested that no herbicides be used.

<u>7 p.m. – 9 p.m. Session</u>

Jan Larson asked when the site selection report would be available. Ms. Fowler stated that it was due to her office on March 31, 2000 and would be made available soon afterwards.

Henry Wolff asked if people would be contacted concerning the status of their suggested projects. Ms. Fowler said that people would be informed of the status of their suggestion. Ms. Fowler also said that even though the USACE and NJDEP might not be able to address all suggested sites now, they might be candidates for restoration efforts by the partners or others in the future.

Progress Report to Barnegat Bay Estuary Program Management Committee (March 21, 2000) – Ocean County One-Stop Center, Toms River, NJ

Objective

The objective of this meeting was to update the BBEP Management Committee on the progress since the first meeting and to present preliminary results. The same presentation used in the February public workshop was made to initiate discussions. The meeting was held near the end of the Management Committee agenda.

Participants

A total of 18 members of the BBEP Management Committee (Appendix 4) witnessed the presentation and participated in the discussion.

Meeting Results

Ms. Fowler provided the context for the presentation and introduced Dr. Southerland. He then repeated his talk from the February 23rd Public Workshop. Because much of the audience had attended his previous presentation, he gave only a brief introduction to the project and focused on the site evaluation methodology. He also provided an example of site scoring for each criteria. After the presentation, Dr. Southerland and Ms. Fowler solicited comments from the Committee members.

Mike DeLuca of Rutgers University asked whether we had recently contacted Paul Bologna about the selected SAV sites. He indicated that Paul has information on the sites most appropriate for restoration of SAV and the appropriate planting times. Dr. Southerland said that Versar had indeed talked to Paul and included his suggestions in the site selection criteria for SAV. Dr. DeLuca also suggested that Versar contact Rick Lathrop of Rutgers to obtain information on another SAV targeting method he has developed. Dr. DeLuca also described an educational program that encourages grade school students to grow and plant SAV. **(Morris, Mike D. directed us to someone specific. I believe it was a name like Janice MacDonald, but I'm not sure. Could you please check with Steve & Mark?)**

Tom Fote of the Barnegat Bay Watershed Association asked whether we had considered the idea put forth by Gef Flimlin at the last public workshop of promoting clam aquaculture to establish SAV beds. Ms. Fowler said that we had considered the idea, but that we needed a specific proposal from Flimlin on how such an approach would work. She indicated that the projects being considered could not be simply research, but needed to have established methods and a reasonable expectation of restoration success. For this reason, SAV restoration will likely be considered as a pilot project before being implemented on a large scale.

APPENDIX 1

Public Workshop Presentations

Barnegat Bay Ecosystem Restoration Site Selection:

Progress Report

23 February 2000

U.S. Army Corps of Engineers, Philadelphia District

New Jersey Department of Environmental Protection

Agenda

- Introduction to Site Selection
- Site Selection Process
- Example Site Evaluations
- Next Steps

Introduction

What is Site Selection?

- Goal: Identify the Best Opportunities for Ecosystem Restoration Through Federal/non-Federal Projects in the Barnegat Bay Ecosystem
- Time Frame: Site Selection by 31 March 2000
- Next Step: Conduct a Feasibility Study and Environmental Assessment for Selected Projects
- Ultimate Result: Improve Ecosystem Conditions in the Barnegat Bay Estuary

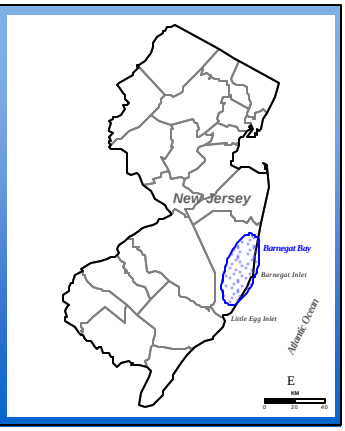
Introduction

Objectives of Site Selection

- Identify Sites With Substantial Problems
- Locate Sites Most Conducive to Restoration
- Select Sites With Fish and Wildlife Habitat Potential
- Identify Multiple Sites Within Sub-Watersheds
- Select Sites of Federal and non-Federal (NJDEP) Interest

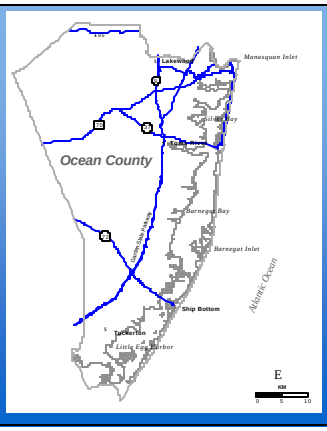
Introduction

Barnegat Bay



Introduction

Barnegat Bay Ecosystem



Introduction

Types of Potential Projects

- Tidal and Non-tidal Wetlands Restoration
- Restoration of Abandoned Lagoons
- Submerged Aquatic Vegetation (SAV) Restoration
- Restoration of Waterbird Habitat and Islands
- Restoration of Fishery Habitat

Site Selection Process

- Input from the Public and Resource Agencies
- Geographic Information System (GIS) Analysis
- Field Investigations
- Site Evaluation

Site Selection Process

Input from the Public and Resource Agencies

- Contacted Federal, State, and Local Resource Agency Staff
- Held Public Workshops
  - 24 January 2000
  - 23 February 2000
- Met with Barnegat Bay Estuary Program, Management Committee
  - 15 February 2000

Site Selection Process

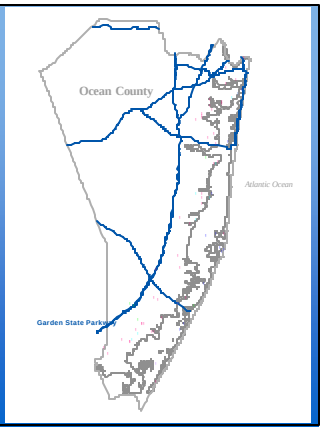
Sites identified through 23 February 2000

- More than 50 sites through GIS analysis
- Approximately 20 sites recommended by resource agencies and the public

Site Selection Process

Sites Identified

- Wetlands
- Abandoned Lagoons
- SAV
- Waterbird Islands
- Fish Habitat



Site Selection Process

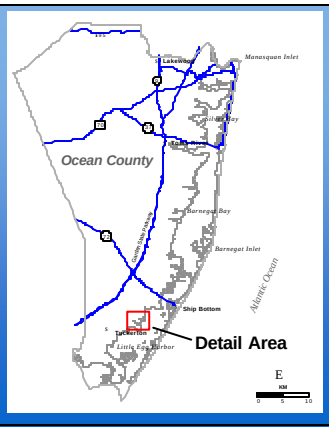
GIS Analysis by Map Overlay to Identify Candidate Sites

- Roads
- Parks and Public Lands
- Bathymetry Data
- Wetlands
- Disturbed Wetlands
- High-quality Islands

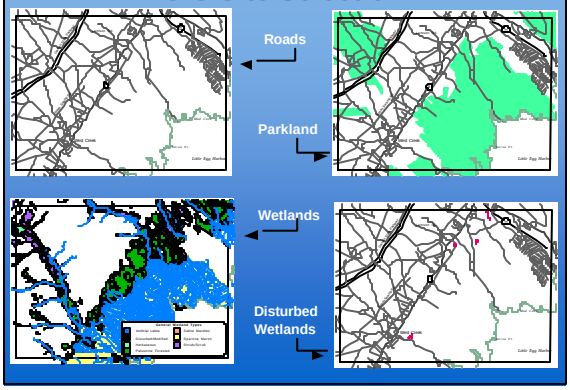
Site Selection Process

GIS Map Overlay Analysis

Example

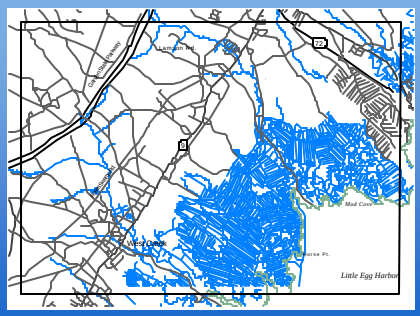


GIS Site Selection



GIS Site Selection

Candidate sites identified by map overlay



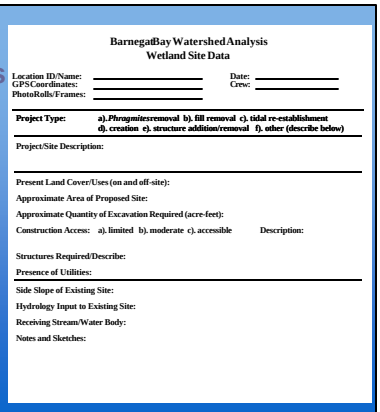
Site Selection Process

Field Investigations

- Field evaluation of more than 60 sites
- Collected photographs, videotape, and global positioning system (GPS) coordinates
- Recorded observations and measurements using custom data sheets for each ecosystem type

Field Investigations

Example wetlands data sheet



BarnegatBay Watershed Analysis
Wetland Site Data

Location ID/Name: _____ Date: _____
GPS Coordinates: _____ Crew: _____
PhotoRolls/Frames: _____

Project Type: a). *Phragmites* removal b). fill removal c). tidal re-establishment d). creation e). structure addition/removal f). other (describe below)

Project/Site Description:

Present Land Cover/Uses (on and off-site):

Approximate Area of Proposed Site:

Approximate Quantity of Excavation Required (acre-feet):

Construction Access: a). limited b). moderate c). accessible Description:

Structures Required/Describe:

Presence of Utilities:

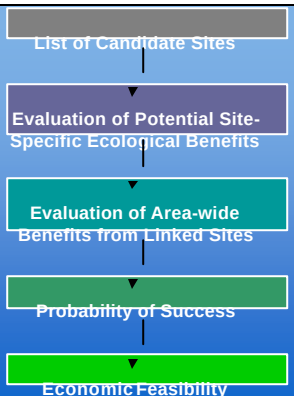
Side Slope of Existing Site:

Hydrology Input to Existing Site:

Receiving Stream/Water Body:

Notes and Sketches:

Site Evaluation Steps



Site Evaluation

Methodology

- **Designate criteria for each category of benefits and feasibility**
- **Customize criteria for each ecosystem type**
- **Assign scores of high, moderate and low for each criteria**

Site Evaluation

Criteria for Site-Specific Ecological Benefits

- Phragmites (common reed)
  - Amount of phragmites indicates the ease of restoration
- Benefit to existing vegetative communities
  - Increase in native plant species and communities
- Wildlife benefits
  - Increase in habitat that supports native terrestrial and aquatic wildlife
- Rare, threatened and endangered species
  - Increase habitat for RTE species

Site Evaluation

Site-Specific Criteria (cont.)

- Anadromous fish passage
  - Open upstream habitat to migratory fish past blockages
- Distance from mainland (islands only)
  - Accessibility by predators and/or humans

Site Evaluation

Criteria for Area-wide Ecological Benefits

- Adjacent to other restoration sites
- Sites in the same sub-watershed
- Potential integration of effort between restoration sites
  - Proximity to source of construction material

Site Evaluation

Probability of Success

- Overall potential for restoration success
  - Simple fixes preferred over complex or uncertain approaches
  - Less maintenance required
  - Higher probability of plant survivorship and sustainable restoration

Site Evaluation

Economic Feasibility

- Ownership
  - USACE and State ownership
  - Other Federal and local government ownership
  - Private lands
- Relative potential costs
  - Accessibility
  - Subsurface conditions
  - Need to avoid sensitive features
  - Risk of hidden impediments

Site Evaluation

Example Scoring

– Site-Specific Ecological Benefits

Site I.D.	1	2	3
Phragmites 100% cover = 3 60-99% cover = 2 0-59% cover = 1	2	1	1
Benefit to existing vegetative communities high = 3 moderate = 2 low = 1	3	2	2
Wildlife benefits high = 3 moderate = 2 low = 1	3	1	3
Rare, threatened & endangered species high = 3 moderate = 2 low = 1	3	1	3
Anadromous fish passage large benefit = 3 moderate benefit = 2 low or no benefit = 1	1	1	3
Distance from mainland (islands only) >2,000 ft. = 3 2,000 to 1,500 ft. = 2 <1,500 ft. = 1	n/a	n/a	n/a
SUB-TOTAL	**12**	**6**	**12**

Site Evaluation

Example Scoring

– Area-wide Ecological Benefits

Site I.D.	1	2	3
Adjacent to other restoration sites within 500 feet = 3 not linked = 0	0	0	0
Other sites in same sub-watershed? yes = 3 no = 0	n/a	n/a	3
Potential integration with other sites potential link = 3 no link = 0	0	3	0
SUB-TOTAL	**0**	**3**	**3**

Site Evaluation

Example Scoring

– Probability of Success

Site I.D.	1	2	3
Overall potential for restoration success certain = 1.0 none = 0	0.95	05	0.95

– Economic Feasibility

Site I.D.	1	2	3
Ownership USACE/state = 3 Other Federal/local = 2 private = 1	2	2	2
Relative potential costs low = 3 moderate = 2 high = 1	2	1	3
SUB-TOTAL	**4**	**3**	**5**

Example Scoring

Total Scores

Site I.D.	1	2	3
SITE-BENEFIT SUMS	12	6	12
AREA-WIDE BENEFIT SUMS	0	3	3
Sum:	**12**	**9**	**15**

PROBABLE SUCCESS	0.95	0.5	0.95
Product:	**11.4**	**4.5**	**14.25**

ECONOMIC FEASIBILITY SUMS	**4**	**3**	**5**

Next Steps in Site Selection

- Complete field investigation
- Finalize site scores
- Develop final conclusions and recommendations for site selection
- Report to the public

Barnegat Bay Ecosystem Restoration Site Selection Project

15 February 2000

U.S. Army Corps of Engineers, Philadelphia District

New Jersey Department of Environmental Protection

Agenda

- Introductions
- What Is the Site Selection Project?
- Project Objectives
- Geographic Focus
- Types of Potential Projects
- Site Selection Process
- How You Can Help
- Potential Project Identification Exercise

What Is the Site Selection Project?

- **Goal:** Identify the Best Opportunities for Ecosystem Restoration Through Federal/non-Federal Projects in the Barnegat Bay Ecosystem
- **Time Frame:** Site Selection by 31 March 2000
- **Next Step:** Conduct a Feasibility Study and Environmental Assessment for Selected Projects
- **Ultimate Result:** Improve ecosystem conditions in the Barnegat Bay Estuary

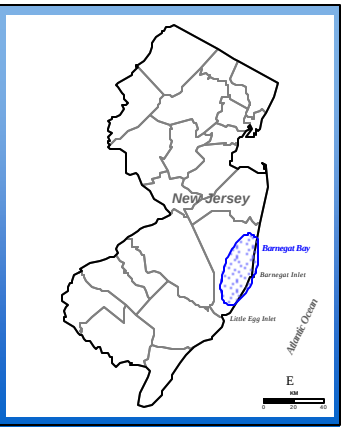
Objectives of the Site Selection Project

- Identify Sites With Substantial Problems
  - to produce the greatest benefits
- Locate Sites Most Conducive to Restoration
  - most likely to be successfully restored
- Select Sites With Fish and Wildlife Habitat Degradation
  - to provide substantial natural resources benefits over time

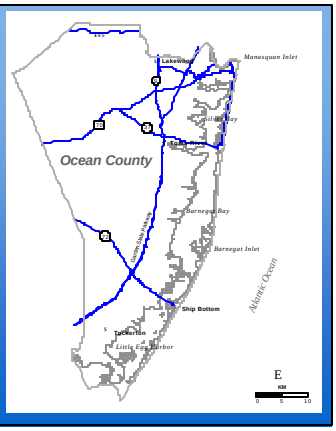
Objectives of the Site Selection Project (cont.)

- Identify Multiple Sites Within Sub-Watersheds
  - Where restoration would benefit large geographic regions
- Select Sites of Federal Interest
  - providing the greatest habitat benefit at the lowest cost
- Select Sites of Interest to the non-Federal Sponsor (NJDEP)

Barnegat Bay



Barnegat Bay Ecosystem

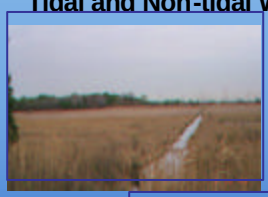
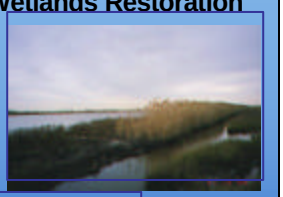
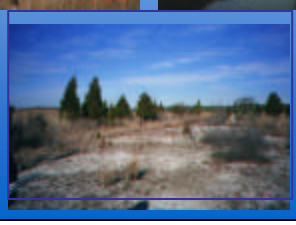


Types of Potential Projects

- Tidal and Non-tidal Wetlands Restoration
- Restoration of Abandoned Lagoons
- Submerged Aquatic Vegetation (SAV) Restoration
- Waterbird Habitat Restoration/Islands
- Restoration of Fishery Habitat: Fish Ladders and Dredged Hole Restoration

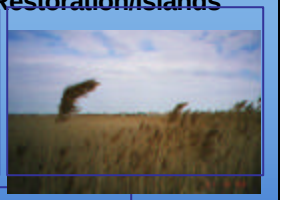
Ancillary Benefits
- Construction of Wildlife Viewing Platforms
- Flood Reduction

Tidal and Non-tidal Wetlands Restoration

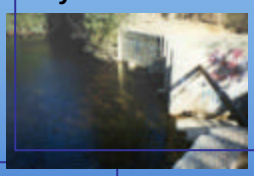
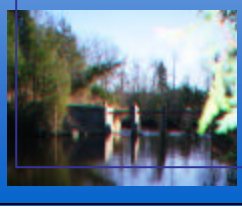




Restoration of Abandoned Lagoons

Waterbird Habitat Restoration/Islands



Restoration of Fishery Habitat

Process for Site Selection

- Input from the Public and Resource Agencies
- Geographic Information System (GIS) Analysis
- Field Investigations
- Priority Ranking

How You Can Help

- Attend Public Meetings
  - 24 January 2000 and 23 February 2000
- Barnegat Bay Estuary Program Meetings
  - 15 February 2000 and 21 March 2000
- Help to Identify Potential Projects
- Support Restoration Actions in Barnegat Bay

Potential Project Identification Exercise

- Maps of Barnegat Bay Ecosystem
- Project Suggestion Card
  - Your Name
  - Your address and phone number (in case we have questions about your suggestion)
  - Location of suggested project
  - Description of suggested project

Barnegat Bay Ecosystem Restoration Site Selection Project

24 January 2000

U.S. Army Corps of Engineers, Philadelphia District

New Jersey Department of Environmental Protection

Agenda

- Introductions
- What Is the Site Selection Project?
- Project Objectives
- Geographic Focus
- Types of Potential Projects
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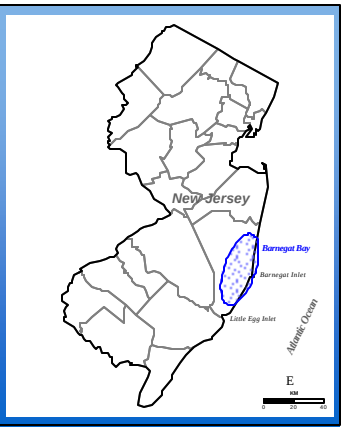

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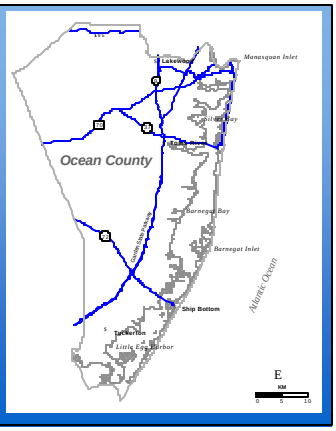

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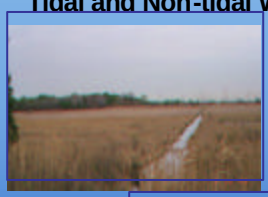
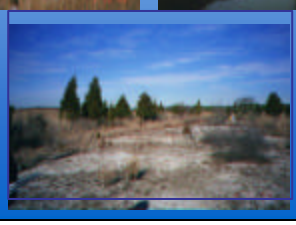
Tidal and Non-tidal Wetlands Restoration





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Restoration of Abandoned Lagoons

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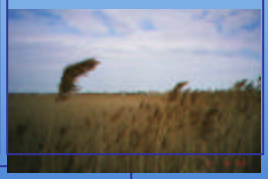
Waterbird Habitat Restoration/Islands



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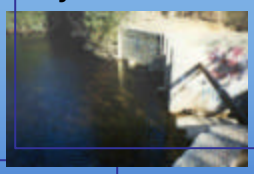
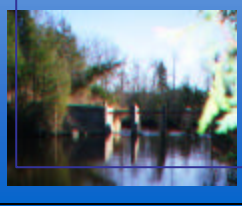
Restoration of Fishery Habitat

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24 January 2000

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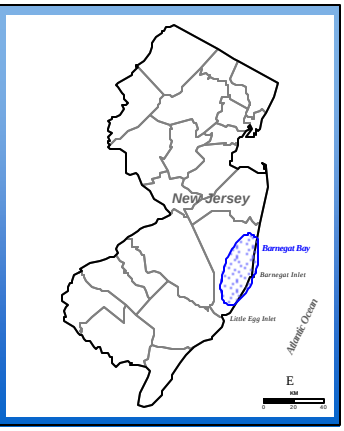
  - to produce the greatest benefits
- Locate Sites Most Conducive to Restoration
  - most likely to be successfully restored
- Select Sites With Fish and Wildlife Habitat Degradation
  - to provide substantial natural resources benefits over time

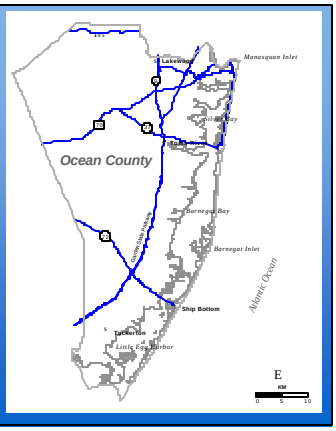
Objectives of the Site Selection Project (cont.)

- Identify Multiple Sites Within Sub-Watersheds
  - Where restoration would benefit large geographic regions
- Select Sites of Federal Interest
  - providing the greatest habitat benefit at the lowest cost
- Select Sites of Interest to the non-Federal Sponsor (NJDEP)

Barnegat Bay



Barnegat Bay Ecosystem



1/24/2000

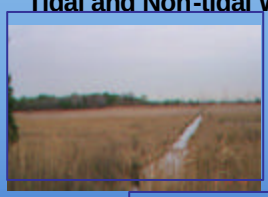
Types of Potential Projects

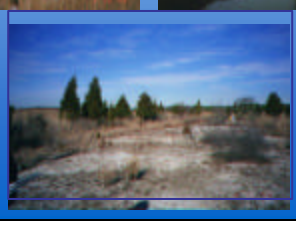
- Tidal and Non-tidal Wetlands Restoration
- Restoration of Abandoned Lagoons
- Submerged Aquatic Vegetation (SAV) Restoration
- Waterbird Habitat Restoration/Islands
- Restoration of Fishery Habitat: Fish Ladders and Dredged Hole Restoration

Ancillary Benefits
- Construction of Wildlife Viewing Platforms
- Flood Reduction

1/24/2000 8

Tidal and Non-tidal Wetlands Restoration



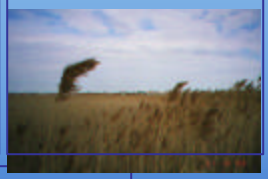


1/24/2000 9

Restoration of Abandoned Lagoons

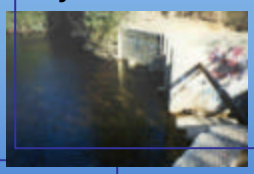
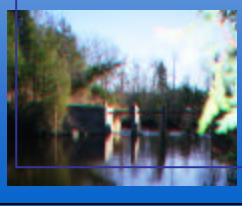
1/24/2000 10

Waterbird Habitat Restoration/Islands



1/24/2000 11

Restoration of Fishery Habitat

1/24/2000 12

Process for Site Selection

- Input from the Public and Resource Agencies
- Geographic Information System (GIS) Analysis
- Field Investigations
- Priority Ranking

How You Can Help

- Attend Public Meetings
  - 24 January, 2000 and 23 February, 2000
- Help to Identify Potential Projects
- Support Restoration Actions in Barnegat Bay

Potential Project Identification Exercise

- Maps of Barnegat Bay Ecosystem
- Project Suggestion Card
  - Your Name
  - Your address and phone number (in case we have questions about your suggestion)
  - Location of suggested project
  - Description of suggested project

APPENDIX 2

Public Workshop (January 24, 2000) and Barnegat Bay Estuary Program Management Committee Meeting– Summary of Project Suggestions

Table 1. Summary comments from January 24, 2000 public workshop and the February 15, 2000 Barnaget Bay Estuary Program Management meeting on Barnegat Bay Ecosystem Restoration Site Selection

Suggestion Numbers (Site Number)	**Name and Address**	**Phone Number/Email**	**Location of and Recommendations for Suggested Project (Versar Comment)**
100 (TWC32)	Horrace Giambattista 1204 Gemini Court Forked River, NJ 08731	(609) 971-7184	Forked River back lagoons. Main channel is 3.5 to 6 feet in depth. The lagoons can be as deep as 16 feet. Flow is restricted in this area, endangering eel pots that are set in the main channel. Recommends dredging the channel. (Visited site on 2/17/00.)
101 & 104A	Russ Palumbo Lacey Township 818 W. Lacey Road Forked River NJ 08731	(609) 693-1100 ext. 8	Lagoon channels associated with Laurel Harbor are causing a reduction in flow, with potential effects to wildlife. Recommends dredging the channel entrances. (Ecological benefit of recommendation is uncertain. Did not visit site.)
102	Henry Wolff 145 Westbrook Drive Toms River, NJ 08757	(732) 349-4931 or (732) 244-1484	Shoaling of Davenport Branch of the Toms River causes diversion of stream, creating stagnant pools and large islands. The condition is conducive for mosquito breeding and impedes stream flow. (Site is well outside study area. Did not visit the site.)
103 & 104 (TWC38)	Paul "Pete" McLain 10 Cedar Drive Toms River, NJ 08753 (Suggestion letter attached in Appendix 3)	(832) 349-6418	Sedge Island Wildlife Management Area (WMA). Recommends reopening (dredging) Mud Channel and develop colonial nesting bird habitat adjacent to Barnegat Inlet. Place fill from mud channel dredging on the Sedge Island marsh area to the immediate north of the inlet (where USACE is installing geotubes for stabilization of the area) to establish colonial nesting bird habitat. (Visited site on 2/28/00.)

Table 1. Continued

Suggestion Numbers (Site Number)	Name and Address	Phone Number/Email	Location of and Recommendations for Suggested Project (Versar Comment)
105 & 106 (TWS39) (TWC38) (ISC08)	William Vibbert NJDEP, Division of Parks and Forestry P.O. Box 37 Seaside Park, NJ 08752	IBSP@eclipse.net	Three potential projects adjacent to Barnegat Inlet: (1) South of inlet, Island Beach State Park south jetty; (2) island inside inlet; and (3) geotube area north of inlet (Little Bay breach). Recommends removing beach grass and phragmites to enhance beach-nesting bird habitat; also recommends adding fencing and appropriate interpretive signs. These sites have a documented history of breeding by nesting birds, including piping plovers, least terns, black skimmers and oystercatchers. Sites should be regraded and the vegetation removed to improve the habitat for these birds. The NJ Beach Buggy Association is interested in collaborating in this effort (see suggestion 106). (Visited sites on 2/17/00 and 2/28/00.)
106 (TWS39)	Bob DeLeonard NJ Beach Buggy Assn. P.O. Box 511 Seaside Park, NJ 08752	(732) 793-8080 wildbob@monmouth.com	See suggestions 105 & 106, above. He is particularly interested in area to the south of the Barnegat Inlet (#106). Recommends eliminating beach grass and phragmites to create/improve habitat for beach-nesting birds (particularly piping plovers). Indicated that he could recruit volunteers to implement the project. (Visited sites on 2/17/00 and 2/28/00.)
107 (LAN05) (LAN06)	Martin Sarrett 543 Carroll Fox Road Brick, NJ 08724	(732) 295-7975	Area near Mantoloking Road. The AF@ cove is an abandoned lagoon (see map on suggestion card). (Visited sites on 2/28/00.)

Table 1. Continued

Suggestion Numbers (Site Number)	Name and Address	Phone Number/Email	Location of and Recommendations for Suggested Project (Versar Comment)
108	Anthony Dantoni 1236 Laurel Blvd. Lanoka Harbor, NJ 08734 Marie Hoefling 1234 Laurel Blvd. Lanoka Harbor, NJ 08734	(609) 242-0335	Same as suggestions 101 and 104A; recommends same action. (Ecological benefit of recommendation is uncertain. Did not visit the site.)
109 (TWN34)	Ruth L. Sarrett 543 Carroll Fox Road Brick, NJ 08724	(732) 295-7975	Crescent-shaped island in South Branch of Beaver Dam Creek, across from 543 and 547 Carroll Fox Road. Dredged material island has been eroding as have other nearby islands. This particular island has been breached in the middle. (Visited site on 2/18/00.)
110 (ISC08)	Jim White 18 Compass Road Waretown, NJ 08758	(609) 693-6320	Island with USACE designation 26A (see also suggestion 104). Indicated that he believes the runoff from this island is killing adjacent SAV. Asked whether we could get rid of the large population of herring gulls that currently use the island. (Visited site on 2/28/00.)
111 (NWS02)	Patrick Filardi 276 Manchester Avenue Lanoka Harbor, NJ 08734	(609) 693-2567	Westecunk Creek, Eagleswood. Recommends investigating the feasibility of constructing fish ladders (or removing blockages) at the Midway Spillway and the Stafford Forge WMA on Westecunk Creek. (Revisited sites on 2/18/00.)
112 (ISC09)	Paul Burrowes III 825 Bowsprit Pt. Lanoka Harbor, NJ 08734 (Submitted by facsimile; included in Appendix 3)	(609) 971-7192	Island north of Cedar Point at the south side of Cedar Creek. The island has eroded noticeably in recent years. Recommends designing a project to stabilize the channel and restore the island. (Visited site on 2/28/00.)

Table 1. Continued

Suggestion Numbers (Site Number)	Name and Address	Phone Number/Email	Location of and Recommendations for Suggested Project (Versar Comment)
113 (TWN36)	Mrs. Patricia Terpanick 20 Mobile Avenue Woodbridge, NJ 07095 (Submitted by letter; included in Appendix 3)	Not available (N/A)	Toms River, Bay Shore development. Recommends removing remnants of old marina, including dilapidated pilings dangerous docks, and garbage. (Visited site on 2/18/00.)
114 (TWS31)	Borough of Tuckerton (telephone call to T. Fowler of USACE on 28 January 2000)	N/A	Three lagoons on Thompsons Creek, near Tuckerton. Recommends dredging Thompsons Creek to improve flushing of the lagoons. There is concern that a heavy slug of pollutants is currently brought in during storm events. They feel dredging the creek would even out the input of pollutants into the lagoons. (Visited site on 2/17/00.)
201 (TWN35)	Joseph V. Tomasi 23 Bayway Brick, NJ 08724	(732) 864-9757 or (973) 256-9173	Kettle Creek channel, between Brick and Toms River. Channel has filled in with sand, making navigation difficult. Recommends dredging channel. (Visited site on 2/18/00.)
202 (TWN33)	Dawn and Eric Wagner 1632 Mayfair Ct. Point Pleasant, NJ 08742	(908) 892-0945 ericwag@att.com	Salt marsh off Beaver Dam Creek, Point Pleasant Borough between Bayhead Shores and Sunshine Harbor developments. Marsh is rapidly eroding owing to boat wakes and goose foraging. Recommends revegetation and erosion control in eroded marsh (note good map on back of suggestion card). (Visited site on 2/18/00.)

Table 1. Continued

Suggestion Numbers (Site Number)	Name and Address	Phone Number/Email	Location of and Recommendations for Suggested Project (Versar Comment)
301 (TWS38)	Bill Hammarstrom 11 Roberts Road Waretown, NJ 08758	(609) 693-4281	Sedge Islands - High Harbor Dike (see also suggestion 104). Recommends adding 4,700 ft. of geotube on north side; adding 1 mile of geotube on west side of dike; and dredging the northwest from lighthouse to main channel. (Visited site on 2/28/00.)
302 (TWC37)	Paul E. Butow, Jr. Councilman, Borough of Oceangate 151 E. Longport Ln. 100 Ocean Gate, NJ 08740	N/A	Jeffrey=s Creek, Ocean Gate Drive. He is concerned about erosion on the banks of stream, in a natural wildlife corridor. Fecal coliform count is high. Road is threatened with increased erosion; silt deposition is causing shallow bed. (Visited site on 2/18/00.)
303	Pat Johnson Tuckerton (dropped off type-written form)	(609) 494-5900 ext. 3035 or (609) 296-2162	Lake Pohatcong, Tuckerton Borough. Recommends dredging to create a Aswimmable lake@ and improve water quality emptying into the Bay. (Site visited as part of the feasibility study on fish passage opportunities at Lake Pohatcong.)
304 (SAC08)	Dr. Paul Bologna Rutgers University 132 Great Bay Blvd. Tuckerton, NJ 08087	(609) 296-5260 ext. 255 bologna@imcs.rutgers.edu	Little Egg Harbor and Sedge Islands. Recommends initiating SAV restoration efforts through experimental plots. Plots could be done within varying planting densities and techniques; the timing of planting is also an important factor (recommends planting in fall/winter). He also indicated that Shelter Island has the best SAV that he has seen and may be a good seed source. (Did not visit any SAV sites owing to absence of vegetation during winter field investigation.)

Table 1. Continued

Suggestion Numbers (Site Number)	Name and Address	Phone Number/Email	Location of and Recommendations for Suggested Project (Versar Comment)
305A&B	Robert R. Fiorile Environmental Design Group 582 Plaza Terrace East Brick, NJ 08732	(732) 477-3203 rrf@birdsall.com	Manasquan River near Glimmer Glass. Recommends two projects: (1) eradicate phragmites and plant with native species, (2) plant spartina to enhance existing mudflat. (These two sites are well outside the study area. Did not visit the site.)
306	Michael S. Sinnema Environmental Design Group 582 Plaza Terrace East Brick, NJ 08732	(732) 477-3203 ms@birdsall.com	Manahawkin Bay. Recommends restoring SAV near Route 72 in areas far from the Intercoastal Waterway. (Did not visit any SAV sites owing to absence of vegetation during winter field investigation.)
307	Mr. & Mrs. Spencer 1349 Laurel Blvd. Lanoka Harbor, NJ 08734	(609) 242-2820 roseannes@aol.com	Laurel Blvd. Areas with abandoned lagoons, erosion, wetland loss, dredged area (last spring), and development. Recommends considering cutting new channel to provide access and remove need to keep lagoons open. (Ecological benefit of recommendation is uncertain. Did not visit the site.)
308	Joe Rizzo N.J. Shellfisheries Assn. 845 S. Main Street Mayetta, NJ 08092	N/A	Dredged hole along bank of N. Oyster Creek at Forked River. Dead vegetation in hole producing a dead zone (see map/sketch on suggestion sheet). (Dredged hole sites were not visited as part of the field investigation owing to insufficient time for appropriate data collection.)
309	Joe Rizzo N.J. Shellfisheries Assn. 845 S. Main Street Mayetta, NJ 08092	N/A	Sunks [sic] behind bulkheads along Long Beach, north of bridge, near Surf City. (Dredged hole sites were not visited as part of the field investigation.)

Table 1. Continued

Suggestion Numbers (Site Number)	Name and Address	Phone Number/Email	Location of and Recommendations for Suggested Project (Versar Comment)
501	Angela Anderson American Littoral Society P.O. Box 1306 Tuckerton, NJ 08087	(609) 294-3111	Recommends control phragmites on old dredged materials disposal island (Ham Island) and promoting songbird habitat. (Did not visit site owing to access problems.)
502 (TWS30)	Angela Anderson American Littoral Society P.O. Box 1306 Tuckerton, NJ 08087	(609) 294-3111	Recommends removing phragmites from channel to Big Thorofare Creek. (Visited site on 2/17/00.)
None	Rudy Moni 540 Princess Ct. Toms River, NJ 08753	(732) 270-1830 moni_rudy @adelphia.net	No specific recommendations. Wants to get on mailing list.
None	John F. Boyle Forked River Mountain Coalition 801 Lakeside Drive North Forked River, NJ 08731	(609) 242-3042	Wants to be put on mailing list.
None	Ms. Jan Larson Rutgers Cooperative Extension 1623 Whitesville Rd. Toms River, NJ 08755	(732) 505-3671 larson @aesop.rutgers.edu	No recommendations.
None	Gary DeFranco 1009 Devon St. Forked River, NJ 08731	(609) 971-3362	Made a general suggestion that future dredging projects and disposal needs should be considered and planned prior to restoration of any sites.

APPENDIX 3

Additional Workshop and Meeting Materials
(including details on sites recommended by the public and newspaper articles)

Public Meeting Announcement:

Barnegat Bay Ecosystem Restoration
Feasibility Study

The U.S. Army Corps of Engineers (USACE), Philadelphia District and the non-federal sponsor, The New Jersey Department of Environmental Protection, invite you to participate in their investigation of ecosystem restoration opportunities in Barnegat Bay and adjacent lands. The project team is soliciting input from agencies, organizations, and individuals on ecosystem and fish and wildlife habitat restoration opportunities in the following areas:

- tidal and non-tidal wetlands
- submerged aquatic vegetation
- abandoned lagoons
- fishery habitat
- waterbird habitat and island creation

Once potential ecosystem restoration sites have been identified and evaluated, a suite of high-priority restoration opportunities will be selected. These high-priority restoration opportunities will be used to target USACE and non-Federal restoration efforts within the Barnegat Bay ecosystem.

Meetings to introduce the project and gather public input will be held:

Monday, January 24, 2000, 4:00 p.m. to 6:00 p.m. & 7:00 p.m. to 9:00 p.m.

Ocean County Library
Lacey Township Branch
10 East Lacey Road
Forked River, NJ 08731

Follow-up meetings to present preliminary results and gather additional public input will be held:

Wednesday, February 23, 2000, 4:00 p.m. to 6:00 p.m. & 7:00 p.m. to 9:00 p.m.

Ocean County Library
101 Washington Street
Toms River, NJ 08753

For additional information please contact Theresa Fowler at (215) 656-6575.

U.S. Army Corps of Engineers,
Philadelphia District

New Jersey Department of
Environmental Protection

FOR IMMEDIATE RELEASE
CONTACT: Terry Fowler
(215) 656-6575

BARNEGAT BAY ECOSYSTEM RESTORATION TEAM MARKS PROGRESS

Toms River……The U.S. Army Corps of Engineers (USACE), Philadelphia District and New Jersey Department of Environmental Protection invite you to participate in their investigation of ecosystem restoration opportunities in Barnegat Bay and adjacent lands. On January 24, 2000 the project team solicited input from agencies, organizations, and individuals on ecosystem and fish and wildlife habitat restoration opportunities in the following areas:

- tidal and non-tidal wetlands
- submerged aquatic vegetation
- abandoned lagoons
- fishery habitat
- waterbird habitat and island creation

The first meetings netted excellent ideas from approximately 50 participants. The project team has now been moving forward with analysis of the opportunities gathered through these meetings, computer-based geographic information systems, aerial photographs and field visits. The second meetings will be held on Wednesday, February 23 from 4-6 PM and 7-9 PM at the Toms River Branch of Ocean County Library at 101 Washington Street in Toms River. All concerned citizens, agency representatives and elected officials are invited to attend for a progress report on the site selection process.

The site selection process is part of an extensive, ongoing effort. Site selection was preceded by a study report, completed in July 1997, which identified specific problems and opportunities and concluded that a feasibility study for ecosystem restoration should be conducted. Once potential ecosystem restoration sites have been identified and evaluated, a number of high-priority restoration opportunities will be selected. These high-priority restoration opportunities will be used to target USACE and non-Federal restoration efforts within the Barnegat Bay ecosystem. The study and future Corps work within the Barnegat Bay watershed will coordinate with the action plans and goals of the Barnegat Bay Estuary Program.

Several cases of environmental degradation and their contributing factors are identified in the initial study. Previously existing dredge holes have created pockets of lifeless seabottom, where neither shellfish nor other bottom feeders can live. Certain fish require both saltwater and freshwater environments, which requires swimming upstream into the Bay's tributaries. Some of these rivers or creeks are obstructed by

dams or other obstacles that prevent these fish from completing their life cycle in their natural habitat. Fishladders might help restore these fish populations. Abandoned lagoons in the area may prove to be useful in creating open water wildlife areas and wetlands. These are just some of the projects the Corps has identified for potential restoration.

Make use of your personal and/or professional knowledge on these issues and share your expertise with the ecosystem restoration team on Wednesday, February 23, 2000 from 4 to 6 PM or 7 to 9 PM at the Toms River Library.

FOR IMMEDIATE RELEASE
CONTACT: Terry Fowler
(215) 656-6575

BARNEGAT BAY ECOSYSTEM RESTORATION TEAM SEEKS INPUT

Toms River……The U.S. Army Corps of Engineers (USACE), Philadelphia District and New Jersey Department of Environmental Protection invite you to participate in their investigation of ecosystem restoration opportunities in Barnegat Bay and adjacent lands. The project team is soliciting input from agencies, organizations, and individuals on ecosystem and fish and wildlife habitat restoration opportunities in the following areas:

- tidal and non-tidal wetlands
- submerged aquatic vegetation
- abandoned lagoons
- fishery habitat
- waterbird habitat and island creation

The first meetings will be held on Monday, January 24 from 4-6 PM and 7-9 PM at the Lacey Township County Library at 10 E. Lacey Rd. in Forked River. All concerned citizens, agency representatives and elected officials are invited to attend and offer their suggestions and comments.

The site selection process is part of an extensive, ongoing effort. Site selection was preceded by a study report, completed in July 1997, which identified specific problems and opportunities and concluded that a feasibility study for ecosystem restoration should be conducted. Once potential ecosystem restoration sites have been identified and evaluated, a number of high-priority restoration opportunities will be selected. These high-priority restoration opportunities will be used to target USACE and non-Federal restoration efforts within the Barnegat Bay ecosystem. The study and future Corps work within the Barnegat Bay watershed will coordinate with the action plans and goals of the Barnegat Bay Estuary Program.

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useful in creating open water wildlife areas and wetlands. These are just some of the projects the Corps has identified for restoration.

Make use of your personal and/or professional knowledge on these issues and share your expertise with the ecosystem restoration team on Monday, January 24, 2000 from 7 to 9 PM at the Lacey Township Library.

Future notice will be given on the follow-up meeting scheduled for February 23rd at the Toms River Library.

JUST IN... JUST IN... JUST IN...

US Army Corps
of Engineers
Philadelphia District

Wanamaker Building
100 Penn Square East
Philadelphia, PA 19107-3390

FAX Cover Sheet

FAX Number: 410-964-5156

DATE: 3/28/00

TO: Mark Southerland

Location: Versar Inc

Telephone Number: 410-740-6074

FROM: Terry Fowler

Location: USACE Philly

Telephone Number: 215.656.6575

Remarks: Only circled ones.

Number of Pages: 3 (including cover sheet)

Our FAX Number Is: (215) 656-6828
Our FAX Operator Number Is: (215) 656-6820

OCEAN COUNTY Fax:732-506-5370

** Speed-Dial Directory **

P.1

Mar 27 '00 13:29

No.	Remote Location	Telephone Number	Group Number
001	ADVANCE	92-657-2970	2
002	SANDPAPER	92-1-609-494-1437	2
003	LEADER REVIEW	92-899-2135	2
004	NEW EGYPT PRESS	92-1-609-758-1816	2
005	TRI-TOWN NEWS	92-367-6566	2
006	FR GAZETTE	92-1-609-693-8746	2
007	BRICKTOWN NEWS	92-477-8305	2
008	SENIOR. SCOOP	92-922-4818	2
009	BARNEGAT BANNER	92-1-609-978-5498	2
010	GSN NEWS	92-1-908-925-7302	2
011	ASSOCIATED PRESS	92-1-609-392-3525	1, 3
012	CURRENTS	92-1-609-494-5335	2
013	NJAC	92-1-609-989-8567	2
015	MNCHSTR-BRKLY TM	92-657-7388	2
016	OCEAN STAR	92-899-9778	2
017	COMMUNICATOR	92-458-1728	2
018	SR BULLETIN	92-714-0951	2
019	METRO GUIDE TV	92-1-212-324-8699	20
021	OC JOURNAL	92-1-609-698-7209	2
022	WBHX FM	92-1-609-597-5556	2
025	MODC	92-223-1516	2
030	BECK	92-840-9492	10
031	CONOVER	92-892-8748	5, 7.10
032	GUGLIELMELLI	92-905-5897	10
033	ONDRUSHEK	92-1-609-633-7418	10
034	OUGHTON	92-657-2310	10

OCEAN COUNTY Fax:732-506-5370

The group number is fully down to Inquirer

*** One-Touch Directory ***

P.1

Mar 27 '00 13:28

No.	Remote Location	Telephone Number	Group Number
A	APP	92-557-5759	1, 3.20
B	OBSERVER	92-557-5758	1, 3
C	WOBM	92-269-4999	1, 3, 4
D	CABLE 8	92-286-2914	1, 3
E	AC PRESS	92-1-609-978-2001	1, 3
F	STAR LEDGER	92-409-0126	1, 3
H	COMCAST TV	92-920-6017	1, 3
I	WPVI CH-6 TV	92-1-609-823-1215	1, 3
J	WJRZ	92-1-609-597-4400	1, 3, 4
K	TIMES BEACON	92-1-609-597-0341	1
L	MONMOUTH CABLE	92-920-6017	1, 3
M	TRK CABLE	92-1-609-494-7892	1, 3
O	NY TIMES NJ ED.	92-1-212-556-7661	1, 3
P	PHILA INQUIRER	92-1-609-823-3652	1, 3
Q	WHTG	92-493-0813	1, 3, 4
S	BURLINGTON TMES	92-1-609-871-0490	1, 3
T	NEWS NJ	92-417-1484	1, 3
U	NJ NETWORK	92-1-609-633-2927	1, 3
V	WBJB FM LINCROFT	92-224-2494	1, 3, 4
W	WOBM AM	92-364-2462	1, 3, 4
X	NEWS 12 J SHORE	92-280-0723	1, 3
Y	PA	925065000	1, 2, 3, 4, 5---
a	SOC CofC	92-1-609-494-5807	5, 7.10
b	PT. CofC	92-899-0103	5, 7
c	TR CofC	92-349-1252	5, 7.10
d	JACKSON CofC	92-363-1157	5, 7

Heidi - only 1 + 2

[Public Workshop Announcement Mailing List]

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Trenton, NJ 08625

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Twp. Of Little Egg Harbor
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Little Egg Harbor, NJ 08087

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Toms River, NJ 08753

C.E. Aldrich
Dover Twp.
P.O. Box 728
Toms River, NJ 08753

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Dave Barth
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Asbury Park Press Pg 4A Z SUNDAY, JAN. 23, 2000

Corps plans to restore wildlife in Barnegat Bay

By KIRK MOORE
STAFF WRITER

THE ARMY Corps of Engineers is best known along the coast for dredging ship channels and building jetties, but now the corps' planners have a new mission: restoring wildlife and fish habitat in Barnegat Bay.

Public meetings are planned this week to help the Army engineers design a list of "ecosystem restoration opportunities" to be approved by Congress. The open-house-style meetings will be held from 4 to 6 p.m., and 7 to 9 p.m. tomorrow at Ocean County Library's Lacey Branch, 10 E. Lacey Road. Suggestions will be solicited from the public, including area residents, wildlife workers and environmental activists.

Corps workers already have researched computer maps and visited some potential project sites, said project coordinator Theresa Fowler.

"We're bringing it to the public to show them what we've found so far," Fowler said. The project needs suggestions because local people know the bay and surrounding landscape better than anyone, Fowler said.

Congress approved money for the study in September 1995. It is part of a larger movement within the national Army Corps of Engineers to focus more on environmental benefits, especially when projects such as building bird-nesting areas or restoring wetlands can be hitched to the corps' usual workload of navigation projects.

The corps already is involved in a $2.2 million environmental repair job at Island Beach State Park, where it aims to plug a breach in a dike, an opening that threatens wetlands and bird habitat.

The Barnegat projects could include restoring tidal and freshwater wetlands, improving habitat for fish and submerged aquatic vegetation such as eelgrass, restoring abandoned man-made lagoons to a more natural shoreline, and building islands. Shorebird experts have found that nesting colonies of least terns and other rare species thrive on artificial islands of sand left behind from channel dredging.

□ *Kirk Moore: (732) 557-5728*

Your chance to help improve bay conditions

Staff report

TOMS RIVER — Know of a place or a condition in Barnegat Bay that needs fixing?

Federal and state officials would like to know about it.

They'll be at the Lacey Township branch of the Ocean County Library on East Lacey Road in Forked River on Jan. 24, gathering information on restoration opportunities in and around the bay.

The U.S. Army Corps of Engineers and the state Department of Environmental Protection are interested in knowing what needs restoring.

They'll welcome information about:

- Tidal and non-tidal wetlands.
- Submerged vegetation.
- Abandoned lagoons
- Fish and waterfowl habitat.
- Island creation.

The Jan. 24 meeting will be held from 4-6 and 7-9 p.m.

Once it's decided which places will be targeted for restoration, priorities will be set.

Future Corps work in the Barnegat Bay watershed will be coordinated with the goals of the Barnegat Bay Estuary Program.

Among the problems identified in a July 1997 study were these:

- Dredge holes created dead pockets on the bay bottom where shellfish and finfish do not live.
- Dams and other obstacles prevent fish from swimming up some of the bay's tributaries. Fish ladders may help them complete the migration needed to complete reproduction.
- Abandoned lagoons need converting into open-water wildlife areas and wetlands.

Ocean Co Observer 1-17-00 Pg A 2

Officials seek help with bay problems

Asbury Park Press 1-17-00 Sec B Front Pg

STAFF REPORT

KNOW OF a place or a condition in Barnegat Bay that needs fixing? Federal and state officials want to know about it.

They'll be at the Lacey branch of the Ocean County Library, East Lacey Road, on Jan. 24, gathering information on restoration opportunities in and around the bay.

The Army Corps of Engineers and the state Department of Environmental Protection are interested in knowing about any problems, including information about:

- Tidal and non-tidal wetlands.
- Submerged vegetation.
- Abandoned lagoons.
- Fish and waterfowl habitat.
- Island creation.

The two-hour sessions at the Lacey library will start at 4 p.m. and 7 p.m. Once officials have decided which places will be targeted for restoration, priorities will be set.

Among the problems identified in a July 1997 study were:

- Dredge holes created dead pockets on the bay bottom where shellfish and finfish do not live.
- Dams and other obstacles prevent fish from swimming up some of the bay's tributaries. Fish ladders may help them complete the migration needed to complete reproduction.
- Abandoned lagoons need converting into open-water wildlife areas and wetlands.

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Officials gather ideas for restoring Barnegat Bay Estuary

■ The Army Corps of Engineers and the state DEP will select the sites to be restored.

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By KAREN SUDOL
Staff Writer, (609) 978-2011

LACEY TOWNSHIP — Bob DeLeonard wants the vegetation on the beach near the Barnegat Lighthouse — that has forced piping plovers to nest elsewhere — removed so the tiny birds will return.

Paul Bologna's concern is the lack of any submerged aquatic vegetation on the south side of Little Egg Harbor near Shelter Island. Bologna, of Rutgers University, is proposing the Army Corps of Engineers and state Department of Environmental Protection restore the vegetation there.

Both men offered proposals to restore the Barnegat Bay Estuary at a public meeting Monday afternoon.

The meeting — the earlier of two on Monday — was arranged by the Corps and DEP, which are seeking public input to determine the best ways to restore portions of the estuary.

The Barnegat Bay estuary extends from the Point Pleasant Canal to Little Egg Harbor Inlet, according to Terry Fowler, the Army Corps of Engineer's Philadelphia district project manager.

The agencies have set aside $1.25 million each to perform a joint feasibility study that will help determine the most advantageous ecosystem restoration sites.

Ideas could include anything from restoration of waterbird habitats to freshwater wetlands or even abandoned lagoons, explained Fowler.

The agencies expect to receive between 50 and 100 ideas. They'll choose several sites, said Fowler.

At Monday's meeting at the Lacey branch of the Ocean County Library, more than a dozen ideas were proposed. The suggestions were noted with small red pieces of tape placed on maps of the estuary.

Among those ideas was DeLeonard's to lure the piping plovers back to a former nesting site.

Eight years ago, an expansive beach on the Barnegat Light side of the inlet

☐ See Bay, Page C4

Bay

(Continued from Page C1)

became overgrown with phragmites, said DeLeonard, president of the New Jersey Beach Buggy Association.

The growth caused piping plovers to flee because the birds dislike that type of vegetation, said DeLeonard.

DeLeonard proposes replacing the phragmites with vegetation the plovers find more favorable.

"I want them to be a nuisance there," he joked.

In his proposal, Bologna said the south side of Little Egg Harbor, once home to submerged aquatic vegetation in the 1970s, is barren. A build-up of sediment in the area has eliminated the vegetation and fish and crabs.

He suggests the Corps replant some of that vegetation to encourage fish and crabs to return.

All of the sites will be researched over the next month by the agencies. At a Feb. 23 meeting at the Toms River branch of the Ocean County library, the agencies will present the results of that research, said Fowler.

Putting the Bay Back Together

Army Engineers Plan Restoration Effort

By LARRY SAVADOVE

There are moves on to buy up tracts of land around Barnegat Bay to keep them from being developed. There are moves to stop pollution from running into the bay. There are moves to clean up the streams and watersheds that feed the bay.

Now the Army Corps of Engineers is moving to restore chunks of the bay to a condition as close to pristine as possible. Some 40 people crowded into the Lacey Branch of the Ocean County Library Monday to hear how, and to present suggestions of where.

It's in the nature of engineers to be precise, to plan carefully to foresee consequences. Unfortunately, the Philadelphia office of ACE didn't check with the New York office, which was holding hearings in Fort Monmouth on ocean dumping at the same time. Otherwise attendance might have been higher.

Still, the number of people who showed up in spite of the scheduling conflict heartened ACE's Terry Fowler. Several concerned groups, a lot of individuals and many media representatives wanted to know what ACE had in mind.

David Gard

POINT TAKEN: Morris Perot (left) of Versar, the company contracted by the U.S. Army Corps of Engineers to work on restoration projects in Barnegat Bay, asks for input from (center) Robert Fiorile and Michael Sinemma (right) at a workshop held in Lacey Monday to determine what sites need help most.

Being methodical, Mark Southerland — who works with Versar, a private company ACE has contracted for the job — started with a quick slide presentation that showed, among other things, just where Barnegat Bay is; unnecessary, perhaps, for this crowd but the company has already done similar work in Chesapeake and Delaware bays.

Then there were pictures of the kinds of damage that are considered reversible — places where piles of fill or dredge material clog the marsh; arrow-straight drainage ditches that provide no shelter for wildlife; stands of alien phragmites; abandoned lagoons.

"These are things we can do something about," said Southerland. Specifically, ACE is turning its attention to five "restoration opportunities": tidal and non-tidal wetlands, submerged aquatic vegetation, abandoned lagoons, fish habitats, and water bird habitats. The company also plans to provide wildlife viewing platforms at certain spots and to work on flood reduction.

To proceed, ACE wants input from government agencies as well as the public. It will combine their recommendations with data gathered from its geographical information system — essentially maps and charts that show concentrations of such things as eelgrass and spartina, fish breeding grounds, clean water and the like.

"The next step is field investigation," said Southerland, "going out and taking a good look." After that, ACE will prioritize the projects, coordinating its efforts with the state's Barnegat Bay Estuary Program and other agencies working on keeping the bay healthy.

"How many dollars are we talking about?" someone asked.

"We have $2.5 million for this feasibility study," said Fowler. "After that, it depends on what we come up with."

This site selection process actually started in July 1997 with the completion of a report that identified some specific problems in the bay and evaluated their potential for solution.

"We want to go out and study the relationships among the sites, and between the sites and their environments," said Southerland. That is, how "fixing" one might affect another. By overlaying maps that show where the fish are with others that spot subaquatic vegetation or bird colonies, some sites might float to the top.

Fowler said there are no set criteria that might weight one over another — better fish nurseries, for example, or thicker eelgrass — but some of the Versar staff people said later they do have their eyes on some particular sites that came from the preliminary report. Previously existing dredge holes have created pockets on the bay bottom where neither fin fish nor shellfish can exist. Some fish that must swim up streams to spawn can't get there because of obstructions; fish ladders might work. Abandoned lagoons could be turned into wildlife havens.

Beach Buggies To Aid Plovers

Then it was "Let's go to the maps." Versar and ACE staffers manned two long tables spread with full maps of the bay. People gathered around with their own maps in hand — in some cases, aerial photos — promoting the dredging of this lagoon or the replanting of that stand of spartina.

Bob DeLeonard, who heads the Beach Buggy Association of New Jersey, presented a plan to put the piping plovers back on the beaches of Barnegat Light.

"You have to scrape off the phragmites (tall, plumed reeds that grow thick and tall and fast, not native to these parts). They make the plovers nervous because they conceal predators." He wants to replant with sea rocket, a short plant that forms enough of an overlay to hide the plovers but not the gulls, feral cats, foxes, opossums and other creatures who fancy plover pie.

"You have to work at it, dig deep to get all the roots. Some of our members are in construction so it wouldn't cost you anything," he added, for emphasis.

Why would beach buggy fishermen push to preserve the piping plover?

"Because we're getting blamed for their decrease. They're trying to shove it down our throat and drive us off the beach. We promote reasonable and responsible access to the beach for surf fishing. We don't run over birds."

A resident in a retirement home in Barnegat said "somebody is dumping trash" in a nearby stretch of woods. Some fishermen were interested in "hardening" sedge islands by Barnegat Inlet. A Tuckertonian had photos of a lagoon "that's got no decent bottom anymore."

What ACE and Versar can do is remove fill, dredge channels, even re-create the zigzag meander of the ditches through the marshes that were once straightened for mosquito control. So what about mosquitoes? The old theory was to leave them no stagnant water to breed in. The new theory turns that around.

"There are other water management techniques now," said Versar's Steve Harriott. "You actually increase water retention time in the marsh. You create ponds that you can then stock with mosquito-eating fish. It makes sense and it works well."

Helping Bays Requires Public Interest

Versar has applied several new techniques to jobs for ACE in the Chesapeake and Delaware bays during the last 20 years.

"One thing we found, though," said the company's William Burton, "is to ask the public. We have generic projects — restore wetlands, replant scraped bottoms, things like that — but the people who live and work there know what needs doing better than we do."

Monday's sessions were designed with Fowler, who had headed the Barnegat Bay Estuary Program in its early stages and was aware of both the level of public concern over the health of the bay and the trouble people have making connections to such bodies.

"This is a way of opening the door," she said.

The door opened, many people rushed in. "Some even stopped here on their way up to Fort Monmouth," she said. There was that, plus the rotten weather; "I was surprised at the turnout."

As people filled out forms to locate suggested sites, staffers put corresponding, numbered red tabs on the maps, like a battle plan.

"We want to hear from everybody with a stake," said Burton. "The people who use the resource know best."

"This is more a workshop than a hearing," added Harriott. "It's important that we get as many candidates in the soup as possible."

The next step is the report to be delivered at a public meeting on Feb. 23, with sites listed by priority and an action plan.

"This thing makes sense," said one participant. "You can't save the bay as an entity. You save the parts, whatever you can." ✧

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CLAMS FROM CONGRESS WANTED

Feds eye program to restore bay ecosystems

By KIRK MOORE

TOMS RIVER — Federal waterways engineers have a list of about 60 places along Barnegat Bay where environmental damage might be undone with the Army Corps of Engineers' "ecosystem restoration" program.

"We want to pick the ones we're most confident will be successful using proven techniques," said consultant Mark Southerland, during a public briefing here Feb. 23 on the Army Corps' plans.

Bay clammers came with another idea that they suggest might save the bay's dwindling shellfish and underwater eelgrass beds — using some commercial clam-growing beds in southern Ocean County as a source for eelgrass transplanting, shelter for almost-extinct bay scallops, and a reservoir of clam seed to rejuvenate the wild population.

"There used to be 40 clam boats in Parkertown (on Little Egg Harbor). Now there are none. There used to be 10 clam houses (dealers) on Green Street in Tuckerton, now there are two," said Gef Flimlin of the Rutgers Cooperative Extension Service, who with clammer Charles McCarthy of Stafford pitched their idea to the Army Corps.

Many of the Army Corps' candidate sites are degraded wetlands, including a few man-made lagoons that were hurriedly dug and then abandoned when the first wetlands laws shut down housing developments on the bay's salt marshes.

Other possible projects could aim to build new nesting areas for waterbirds, or help eels and herring get around old dams on the bay's freshwater tributaries. Of the 60 sites on the list, about 20 came from suggestions during a public session held last month in Lacey, said Terri Fowler, the restoration program coordinator.

By March 31, the Army Corps should have a final list of sites, based on a scoring system that accounts for feasibility, environmental benefits, costs and other factors, said Southerland, whose company Versar Inc. of Columbia, Md. was hired to help the Army Corps make those choices.

The Army Corps still needs several years to do feasibility studies and other plans, so construction won't start until "maybe 2003 or 2004, and that's assuming that Congress approves the spending," said Carmen Zappile, acting chief of coastal planning for the corps' Philadelphia district office.

Some projects could aim to remove phragmites, the common reed of European descent that infests marshlands disturbed by human activity and crowds out native plants. Other jobs could be more ambitious, like using sand from dredging projects to build new beach habitat preferred by piping plovers and other endangered and threatened beach-nesting birds.

It's a new mission for the corps that might inspire skepticism from fishermen who have fought the organization over New York Harbor dredging projects, said Thomas P. Fote, a Dover Township angler and legislative chairman of the Jersey Coast Anglers Association.

"We're not used to working in a cooperative relationship with the Army Corps. And we wonder if there's an ulterior motive, like using these projects for (environmental) mitigation banking so the corps can tear up other places," Fote said.

But Fowler stressed the restoration is a cooperative effort with the state Department of Environmental Protection, which supplied the Army Corps with much of the Geographic Information System (GIS) mapping that's being used to pick sites.

Disappearing eelgrass is another concern, and clammer Charlie McCarthy suggested it could be related to the demise of the bay's once-sweeping clam beds. Extensive eelgrass on the bay side of Long Beach Island fostered immense numbers of clams until severe winter ice in the 1970s scoured out the plant roots he recalled.

Clams recolonized those areas, and by the early 1980s eelgrass had returned, McCarthy said. He suggested the plants and shellfish might somehow work together in stabilizing the bay bottom for each other. Bay scallops, once a valuable fishery, have been scarce since the eelgrass went away in the 1970s, he said.

Ironically, regulations aimed at protecting the few eelgrass patches left could hold up the state from granting McCarthy and other clammers leased bay bottom to grow clams that are artificially hatched in aquaculture plants, Flimlin said. It's the last holdover from an industry that once provided 900 fulltime jobs, he added.

The Army Corps and state Bureau of Shellfisheries could work, with the help of clammers and eelgrass researchers, to see if clam production and eelgrass restoration can be managed together, Flimlin suggested.

□ *Kirk Moore: (732) 557-5728*

Joint effort urged to protect Barnegat Bay

By DON BENNETT

When rainstorms wash over Barnegat Bay between Seaside Heights and Mike's Island, pollution is sure to follow, officials from the state Department of Environmental Protection told Ocean County's mayors Feb. 22.

Finding remedies to pollution of the bay — and other bodies of water — will require state, county and local partnerships, said Robert Tudor, assistant DEP commissioner for environmental policy and science.

Tudor said those partnerships, and the management plan now being developed for the Barnegat Bay estuary, will help protect bathing and shellfishing areas, safeguard drinking water and restore troubled areas in the watershed.

The chief challenge to the bay's water quality is nonpoint-source pollution, the kind that has no readily identifiable source, Tudor said at the monthly meeting of the Ocean County Mayors Association in Toms River.

It's an accumulation of things put on the ground — oil, fertilizers, animal waste, garbage, leaves and grass clippings — that are washed into storm drains during rainstorms.

Eliminating known sources of pollution has opened 87 percent of the back bay waters in the state to shellfishing, an increase of about 13 percent since 1974.

Now the pollution fight is focusing on nonpoint-source pollution, and Tudor said there are "significant dollars" from state and federal sources available to help in that fight.

The DEP has been watching the bay and its tributaries for years after storms, trying to learn where the bacteria pollution that often closes bathing beaches comes from.

Robert Connell, an environmental scientist with the DEP's Bureau of Marine Water Monitoring, said 10 years of bay watching pinpointed the bay off Seaside Heights as the place that suffers most from pollution after storms.

After ruling out the former Ortley Beach sewage treatment plant site, animal wastes on the Sedge Islands, marinas and an "incredible amount" of dog waste along the bayfront south of the boat ramp, Connell said two storm drains that jut into the bay were discovered to be the sources of the pollution.

The drains extend under Bay Boulevard, the extension of Route 37 before it connects with Route 35, but Connell said he doesn't know if they go farther east.

If they do, they might be feeding pollutants from the Seaside Heights Department of Public Works yard into the bay when it rains. Garbage trucks are washed there, residents have told the DEP.

In Dover Township, the DEP has been monitoring the Long Swamp stream, the small, meandering brook that flows through the Bey Lea Golf Course and past the Ocean County Mall before forming Johnson's Lake.

It empties into Haines Cove on the Toms River.

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Beach Haven Times

PHRAGMITES GET A GRIP

Reeds weave into habitats

By TRACY ROBINSON

Creeping into New Jersey's marsh and wetlands, the phragmite has planted itself as a permanent resident, uprooting other natural vegetation and moving into wildlife habitats.

A recent Rutgers study of local marshlands has shown the encroachment of the reed grass is harmful to certain fish and other animals.

Phragmites, which are also called crow grass by old-timers or bay reeds by others, have been around for thousands of years, according to experts. Although their existence is not new, the fact that they are taking over the areas in which they grow is becoming a clear concern.

"What it is doing is replacing the natural salt marsh grasses and that is one of the reasons that people are concerned," said Glen Able, director of the Rutgers University Marine Field Station in Tuckerton.

"Because it is unnatural, in that sense it has a negative impact," Able said.

Whereas phragmites used to occur only in areas where marshes and forests met, in recent times they have extended their range so they cover the whole marsh area, according to Able.

The scientist said he doesn't have enough data yet to determine if the increasing coverage of phragmites means a negative impact overall, but he does know it is harmful to certain fish.

"In the last couple of years we have collected enough data to show it does have a negative impact on fish populations in the marsh," Able said speaking of the larval and small juvenile phases of mummichogs or minnows.

Although they are small fish which are well known by fisherman who use them for bait, the negative impact on minnows is important because they are the most abundant fish in the marshes and are essential to the food chain there.

Mummichogs/minnows are a predator of smaller sea life and are also prey for larger fish such as weakfish and striped bass, Able said.

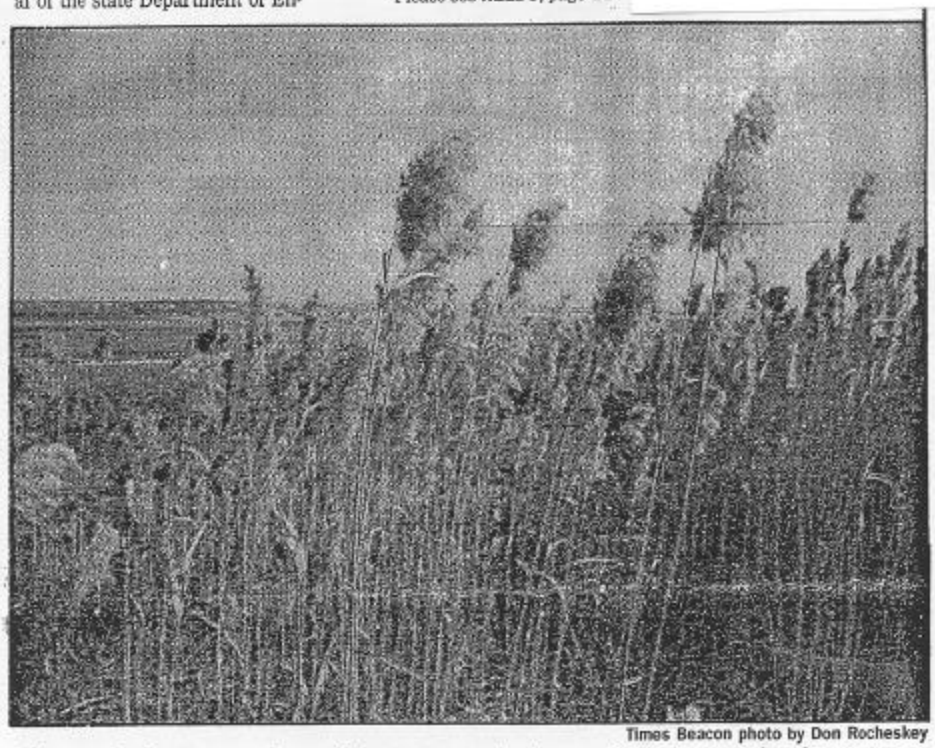
At the Tuckerton Seaport Baymen's Museum, Program Director Terry O'Leary is trying to get rid of the reeds with the approval of the state Department of Environmental Protection and the U.S. Army Corps of Engineers.

O'Leary said the phragmites are, "really hard to get rid of," yet he is still trying due to concerns about the animals who live around the marshlands.

According to O'Leary, phragmites like the areas where two different landscapes meet known as transition zones. Yet animals also like these areas and they don't feel as safe in them as they get crowded with more reeds.

The phragmites choke out other vegetation and shrub-like trees in which birds such as the

Please see **REEDS**, page **11**



Times Beacon photo by Don Rocheskey

These reeds known as phragmites, are growing in numbers, increasing in coverage and overtaking habitats for local wildlife, according to area scientists and naturalists. Also called bay reeds or crow reeds, these phragmites were photographed along Great Bay Boulevard in Little Egg Harbor Township.

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Reeds

rom page 1

nowy egrets nest. And, the root ructures of the plants are also o strong and widespread that hey make it hard for some crusaceans like fiddler crabs to burrow.

"They like to be on the edge of a tidal creek but the reeds have roots everywhere so there is no place for them to dig a burrow," O'Leary said.

Turtles also feel the effects, he said.

Diamondback terrapins for example, need dry land to lay their eggs in, yet the reeds keep the land wet because they shade it from the sun.

For these reasons, O'Leary is battling the fierce reeds with some success by mowing and also by applying herbicides.

At the seaport, he said he has had to place herbicide on the plants individually so as not to get rid of wanted vegetation.

"We actually had to dab it on each plant we wanted to kill," O'Leary said.

Another plan involved hand sickling each of the plants with help from Department of Corrections workers which has been successful so far if not tedious, he said.

Other methods attempted were burning the reeds, which can be dangerous and uncontrollable.

"A fire in the reeds is a very fast and hot burning fire, and how do you get a fire truck in the marsh," O'Leary said. "They (phragmites) are really hard to get rid of."

Yet for the sake of nature, many keep trying.

The results of Able's research will soon be published in a journal called "Estuaries," he said.

"It is a very very important issue and what we are trying to do is shed some light on it," Able said.

He has been gathering research for the past four years and is currently funded by both PSE&G and the National Sea Grant program.

Army Corps Weighs Nearly 70 Sites

Deciding Priorities For Bay Restoration

By LARRY SAVADOVE

How do you do triage on a body of water? How do you decide what parts need immediate attention, what parts can wait and what parts are past help?

That's the job the U.S. Army Corps of Engineers has set itself in a project to restore damaged parts of Barnegat and Little Egg Harbor bays. Some areas have been dredged, choked, filled, scraped and poisoned to the point where, without help, they will never be working parts of the ecosystem again.

At a couple of gatherings last month, dozens of concerned groups and individuals met with Versar, the company the Corps has contracted with, to suggest sites they'd like to see restored added to those that have already been tagged.

Last week Versar representatives presented the results — almost 70 places around the bays and their watersheds where it might, *might*, be possible to bring back nature.

"We can't do them all," said Carmine Zappile, acting head of the Corps' Coastal Planning Division. "Now we have to go through a final process of selection."

Not an easy job. Versar's Mark Southerland put up a map that showed the sites selected for further study. Colored dots were scattered like M&Ms across almost every section, each color representing one of the five areas of concern: wetlands (tidal and freshwater), submerged aquatic vegetation (mostly eelgrass), abandoned lagoons (dug before wetlands regulations took hold), fishery habitat (much of it among the eelgrass), and waterbird habitat (largely on the sedge islands).

There were more than 50 wetlands sites, 10 waterbird, eight fishery and eight lagoons spotted as needing help, plus two major areas for submerged aquatic vegetation.

But needing doesn't mean getting. There are limitations — technology, manpower, money. So between now and March 31, Versar will winnow the 70 down to ... what?

"We don't know yet," said the Corps' Terry Fowler, who heads the project. "That's why the feasibility study."

"We want to identify the best opportunities for ecosystem restoration," said Southerland. And Versar has a procedure to do that.

"We first ID sites with substantial problems." These might be dredge holes where the bottom has been rendered lifeless, or blocked streams where fish can't return to spawn, or islands where fill has been dumped.

"Then we must decide which are most conducive to being restored, where our efforts will work. We pay attention to sites where the restoration will benefit fish and wildlife. And we try to find sites that are linked so efforts in one can be tied to efforts in another."

The New Jersey Department of Environmental Protection and the Army Corps settled on several candidates after a preliminary study done in 1997. The recent public meetings added more. An analysis was done using GIS (Geographical Information Systems) maps and overlays to see where affected sites are in relation to such things as roads, parklands, existing wetlands and the like.

Next came the field work — going out and eyeballing the sites. All this resulted in site evaluations where each got a score — a 3 for its potential as fish habitat, say, but only a 1 for eelgrass, or a 2 for wetlands and a 2 for bird habitat and a 2 for being adjacent to another patch of wetlands.

In the end, some 50 sites were selected by the Corps and Versar and 20 more promoted by public organizations and individuals.

"And the question is," said Southerland, "at a given site, can it be done?"

Technologies Proven, Results Are Not

"Is this going to be an experiment or will you use proven technology?" asked Gef Flimlin of Rutgers University Ocean County Extension.

"The latter," replied Southerland, cautioning, however, that "proven technologies don't work in every case."

But, "This isn't a research project," said Fowler. "We're concentrating on what is possible."

"There's good news and bad news," continued Southerland. "The bad news is that there are a lot of messed-up places on the bay. The good news is there are a lot of places with the potential to be fixed up."

In putting together the final list, "simple fixes are preferred over complex ones," he said. "We're looking for sites that are adjacent, where we can go easily from one to the other. We prefer restorations that won't take a lot of maintenance, where native plants can flourish once we clear out the phragmites. We favor islands that aren't too far from the mainland for us to get to easily, but far enough to discourage foxes and raccoons from raiding the nests."

There are always problems. One is the constant possibility of unintended consequences. "We can get rid of phragmites, but we can't be sure of the effects on tidal flow, for example."

Also examined are the subsurface conditions (if a site has been dumped on, what's underneath?), the risk of coming across hidden impediments (old pipelines, septic systems) and the potential effects on rare, threatened or endangered species in the area.

Then there's every project's wall: the budget. Although the feasibility study has been set at $2.5 million, the money for the actual work has yet to be allocated.

"Each job needs a nonfederal sponsor — for example, the state's DEP, or a nonprofit organization. They put up 30 to 40 percent of the funds required. Then the rest must be appropriated by Congress."

Finally there is the matter of whether the site is owned by a federal or state government, or privately.

All of the above are given a numerical rating and the answer comes out "almost scientifically," Southerland joked. "No, it's not rocket science. There has to be an added sensitivity for each job."

Flimlin suggested a way to use clam beds to promote the growth of eelgrass, as demonstrated by a project done successfully in Virginia, "so we get more eelgrass and at the same time get clams back in the bay," a double benefit, he said, "and it costs almost nothing."

Joan Koons of Alliance for a Living Ocean wondered whether dredging Little Egg Inlet had been considered, "to let the water flow in to increase salinity and dissolved oxygen. I'm told it now takes 40 days to flush the bay."

David Gard

***RECOVERY:** One proposal to get the bay back to its previous state is to get rid of the phragmites, a non-native species that chokes the marshes.*

Motives Probed, Mistrust Cited

Tom Fote of the Jersey Coast Anglers Association expressed doubt that anything would come of this effort.

"The way we look at it, it's just another Army Corps project. We have a lot of cynicism with the Corps. It's hard for us to get over strong feelings after 30 years of dealing with you people. You always do things the wrong way. You should have asked us for our opinion before you came up with your own list.

"But," he conceded, "maybe it's not too late. Just having a two-hour meeting, though, isn't the way."

Koons shook her head. "I suggest we forget the past. The past is gone. This is a great moment in time right now where we can do something positive. The Barnegat Bay Estuary Program's report is due soon. There are a lot of good partnerships that can be made."

Fote also wondered how soon the work could be done. "Your projects usually take five years from the date they get approved."

Zappile figured, "Once the feasibility study goes through all the review process — that's about six or seven months from the draft report — there's a period for public comments, so that will take us up to about one year. Then to get nonfederal sponsors, draw up plans, put out for bids — say about 2003 or 2004.

"Assuming, of course, that Congress appropriates the rest of the money."

How much? "When we get our final list, then we'll see what the (nonfederal) sponsors can afford," said Zappile.

Flimlin tried to imagine what results might be possible. "Little Egg Harbor Bay had oysters 100 years ago. They're gone. We used to have bay scallops. They're gone. There's nowhere near the clams there were and the ones that are there are all brown — edible but not marketable."

He sighed. "Just think what could be."

2

113

20 Mobile Ave.
Woodbridge, N.J. 07095
Jan. 17, 2000

Army Corp of Engineers:
State Dept of Environmental Protection:
To Whom It May Concern,

This is in response to the article in the Asbury Park Press dated January 17, about knowing of a place that needs fixing on Barnegat Bay.

Down a home in Toms River Bayshore area, 4 Venetian Court, which is on a lagoon. When boating we come out of our lagoon and must pass behind Bay Bridge Inn, Vicki the Vicki's restaurant. That is the site of an abandoned marina, such an eyesore, with dilapidated pilings and dangerous docks. This is located at the jug handle on Rt. 37 East before going over the Thomas Mathis Bridge, which

leads to Seaside. Many people park their cars on this property and go crabbing from these dangerous piers and leave their garbage everywhere. Occasionally the Dover Township police come and make the people leave, but they're right back.

This area could be made into a beautiful park, with a boat ramp or be developed into a nice marina.

Please ~~do~~ discuss this at your meeting on Jan. 24. I am unable to attend this meeting because I have a disabled child. Thank you.

Sincerely,

Patricia Terpanick

Paul Burrowes III
825 Bowsprit Pt.
Lanoka Harbor, NJ 08734
609-971-7192

facsimile transmittal

112

To:	Ocean County Library, Lacey Branch	**Fax:**	609 --
From:	Paul Burrowes III	**Date:**	01/23/2000
Re:	Corp of Engineers	**Pages:**	2
CC:			

☐ Urgent X For Review ☐ Please Comment ☐ Please Reply ☐ Please Recycle

Ms. Theresa Fowler
Army Corps of Engineers
% Ocean County Library
Lacey Branch

Dear Ms. Fowler

I read with interest of your ecosystem restoration project. Unfortunately business commitments prevent me from attending your Lacey meeting.

I would like to suggest restoration of the small island north of Cedar Point at the south side of Cedar Creek. Lat. 30° 51' 45", Long. 074° 07' 35". This island has diminished noticeably in size over the past several years. Dredging of the Laurel Channel navigation channel may have allowed water currents to erode this feature. I have attached a Terra Server image for your reference.

A program to stabilize the channel and the island could probably work in concert with one-another and prevent the loss of this buffering feature which provides both nesting and respite for birds of various types.

Paul Burrowes III

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Locator

Size S M L

Style Scale

4m

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Topo

Photo

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Image Information

Other Dates:

USGS Topo Map
01 Jul 1981

SPIN-2 Satellite Image
17 Mar 1998

Encarta Articles:

Toms River

94 km S of New York, New York, United States 29 Mar 1995

http://terraserver.microsoft.com/image.asp?S=12&T=1&X=712&Y=5517&Z=18&W=2

THE STATE UNIVERSITY OF NEW JERSEY
RUTGERS
Grant E. Walton Center for Remote Sensing and Spatial Analysis
New Jersey Agricultural Experiment Station · Cook College
Environmental and Natural Resource Sciences Building
Rutgers, The State University of New Jersey
14 College Farm Road · New Brunswick · New Jersey 08901-8551
TEL: 732/932-1582 · FAX: 732/932-2587 · WEB: www.crssa.rutgers.edu

January 24, 2000

Theresa Fowler
U.S Army Corps of Engineers
Philadelphia District
Wanamaker Building
100 Penn Square East
Philadelphia, PA 19107-3390

Dear Terry:

I am unable to attend today's meeting concerning the Barnegat Bay Ecosystem Restoration Feasibility Study but would like to submit these written comments. As you know, I have recently been involved in a study of Habitat Loss and Alteration in the Barnegat Bay Estuary and Watershed as part of the Barnegat Bay National Estuary Program's Data Synthesis and Characterization efforts. Based on results of that work, I have a few personal suggestions as to possible priorities for ecosystem restoration efforts in the Barnegat Bay system.

1. I think the **number one priority** should be waterbird habitat and island creation. Colonial nesting birds are an important component of the Barnegat Bay system and use the bay during a critical period of their life cycle: nesting and rearing young. Several colonial nesting bird species, namely the common tern, black skimmer, Forster's tern, are species of special concern due to their low or declining population numbers. The success of these birds reproduction is sensitive to the availability of high quality island nesting habitat in Barnegat Bay.

While there are a number of islands (over sixty) in Barnegat Bay-Little Egg Harbor, only a small number are heavily used as nesting habitat. The issue is not really the quantity of bay islands so much as their quality. The above colonial nesting bird species need islands that are dominated by either bare sand or low marsh vegetation. Islands that have been colonized by shrubs (e.g., marsh elder) or phragmites reed no longer serve as high quality nesting habitat. As part of the USACE restoration program, the these islands could be periodically cleared of undesirable vegetation and supplemented with clean dredge spoil. In a few instances, several new islands could be created in the central and northern portions of the bay where there are comparatively fewer islands. Dr. Joanna Burger of Rutgers University Department of Ecology, Evolution & Natural Resources and Dave Jenkins of the NJ Department of Fish and Wildlife's Endangered and Nongame Species Program could provide needed guidance on implementation of this program.

2. A **second priority** could be in the restoration of open water-pond habitats to tidal wetlands that have undergone past parallel grid ditching. This form of mosquito control practice has resulted in the loss of subtidal pond habitats in large areas of the bay. In particular, the southern mainland marshes from Mill to Tuckerton Creeks are largely devoid of subtidal pond habitat. These subtidal ponds serve as refugia for marsh fishes and feeding habitat for wading birds, Forster's terns and waterfowl. These habitat components could be reintroduced into these marshes without compromising mosquito control by employing Open Marsh water management (OMWM) techniques. Obviously, we want to careful about mucking around and messing up these otherwise high quality tidal marsh habitats but some judicious use of OMWM in extensive grid ditched areas could be of net benefit. Marsh areas that have not been previously grid ditched (e.g., the Tuckerton Peninsula and Sedge Islands) should be left alone. As many of these marshes are managed as part of the Forsyth National Wildlife Refuge, the U.S. Fish & Wildlife Service would have to be willing partners in this effort. The cooperation of the Ocean County Mosquito Commission would also be needed.

3. A **third priority** should be the construction of fish ladders to restore spawning runs of herring to Barnegat Bay impounded streams as a means of restoring fish habitat. The National Marine Fisheries Service has already identified a number of streams were fish ladders are needed. Deep dredge holes that have demonstrated low dissolved oxygen concentrations could be altered (partially filled) to reduce the water quality problems but still retain some semblance of bottom structure.

4. The filling of abandoned lagoons should be a low priority unless it can be demonstrated that low flushing results in unacceptable water quality (e.g., low dissolved oxygen concentrations). Restoration of these areas would have to carefully done followed by follow-up maintenance to ensure that phragmites reed does not colonize the site. Abandoned lagoons that have been bulkheaded should have the bulkheading removed and the slope of the shoreline restored. This removal of unnecessary bulkheading should be a high priority (see below).

5. Restoration of submerged aquatic vegetation (SAV) habitat is a laudable goal, until the scientific community can determine the cause of SAV (most notably eelgrass) decline, I don't think it will be money well spent. For example, extensive planting of eelgrass beds in areas where SAV beds are declining will not have a high rate of success if water quality problems are not simultaneously corrected. There might be localized situations where past dredging, boat activity or shore/dock structures have obliterated SAV beds. If water quality conditions are sufficient, then SAV habitat restoration (e.g., bottom restoration and planting) might be called for.

6. A further restoration possibility is the removal of unnecessary bulkheading/rip rap and the restoration of natural shorelines. These shorelines and shallow water habitats are important habitats for waterbirds, terrapin turtles, juveniles fishes/crabs and a host of other wildlife species. As a high portion of Barnegat Bay shoreline is bulkheaded, shoreline restoration would be a large benefit especially in areas where the adjacent upland is in a natural vegetation state.

Sincerely,

Richard Lathrop
Associate Professor
Department of Ecology, Evolution & Natural Resources

January 26, 2000

Paul Gaudini, P.E., Chief
U.S. Army Corps of Engineers
Wanamaker Building
100 Penn Square East
Philadelphia, PA 19107-3390

Re: Hearing at Lacey Township Library
January 24, 2000
Site Nbr. 101

Dear Mr. Gaudini:

At the Lacey Library meeting held on January 24, 2000, Jorge Rod (Lacey Township Administrator) and I spoke to you about what we thought were some of the ecological problems in Barnegat Bay along Lacey's waterfront.

So you can have a better understanding of my interest, I have lived in Lanoka Harbor for almost 19 years and have traveled all the waterways in Lacey Township numerous times. I spent five years on the Planning Board, six years on the Township Committee (one as Mayor) and was a strong supporter of some of Lacey's land becoming a part of the Forsythe Preserve along Stout's Creek.

For over ten years I have taken a strong stand on maintenance of our waterways for ecological reasons (water flow) and recreational boating. In this period of time I have seen shoaling at all entrances to our many lagoons at their junction with Barnegat Bay. This shoaling has reduced the water flow to our wetland areas bordering these lagoons.

One of my major concerns is an area approximately 300 to 400 acres just west of Hancy's Pond and Stumpy's Pond. Within the last six to eight years about sixty homes have been built at the end of Laurel Boulevard on waterfront lots and the builders have maintained the only entrance to the bay at Hancy's Pond. It was dredged last year by Albert Marine Construction but is shoaling badly again. This impedes the water flow to all these acres of wetlands. We need greater water flow because of all the additional boats and their added pollution. This has adversely affected fish, fowl and crabs in these lagoon areas.

Last year a petition was signed by 175 residents living on these lagoons, requesting Senator Leonard Connors to seek a permanent solution to water flow and depth at Hancy's Pond.

I have suggested to our Township Committee that we should allow Stumpy's Pond to revert to its natural state (stop all boating and jet skis) and create a new, less dangerous entrance, taking advantage of much bulkheading done by the developer. This entrance should be widened, deepened and bulkheaded and continued due north into a wide, deep lagoon.

As I told you at the meeting, I would be only too happy to show you in person this entire area.

I am enclosing maps of this area for your information.

Sincerely,

Russell C. Palumbo

Russell C. Palumbo
411 Elizabeth Court
Lanoka Harbor, NJ
(609) 971-0589)

Enclosure

C: Jorge Rod, Administrator, Lacey Township

Emily de Camp Herbarium
Island Beach State Park
P. O. Box 37
Seaside Park, New Jersey 08752
(732) 793-0506 Facsimile - (732) 793-4859

10 Cedar Drive
Toms river, N.J.
08753
Jan. 29, 00

Dr. Mark Southerland
VERSAR
9200 Rumsley St.
Columbia, Maryland
21045

Dear Mark,

Enclosed is a copy of a memo which I initially intended to send to Terry Fowler. I added you name on the memo so you could review the proposals. Possibly you could find the 3 by 5 inch card and replace it with this.

I am the volunteer Director of the Emily de Camp Herbarium, which I originated at Island Beach State Park. We have about 400 plants of the barrier island in Riker mounts for the public to view and study. The Emily de Camp Herbarium is a satellite to the Smithsonian for review purposes.

I have been studying the eelgrass and widgeon grass, our only SAV's, since 1968 and intensely since 1995. I prepared the only digitized map of the grass beds in the 40 miles of Barnegat Bay.

I served as Deputy Director of the State Division of Fish,Game and Wildlife for 38 years and retired several years also as a biologist I actually lived on Barnegat Bay 12 months a year.

I can send you our plant list for Island Beach for your reference library, if you are interested.

Best regards,

Pete

Paul "Pete" McLain

Director: Paul "Pete" McLain
Supervisor: Diane Bennett

MEM0 Date Jan. 26, 00

TO : TERRY FOWLER AND MARK SUTHERLAND
FROM : PAUL "PETE" MCLAIN
SUBJECT : SUGGESTIONS FOR BARNEGAT BAY

The following are some thoughts on what might be included in future plans for the rehabilitation of Barnegat Bay. The 3 by 5 inch card I filled out yesterday with a dull pencil may be difficult or impossible to read.

1. Sedge Island Wildlife Management Area just north of Barnegat Inlet. Up until the new south jetty was built several years ago, the only boating channel on the east side of the bay was Mud Channel. As a result of the jetty, the inlet tide opened a big cut in the dike which protected the state-owned tidal marsh. This break channeled the inlet flow of water into and through the marsh and reversed the flow of the tide by 180 degrees and caused the "Cove" to fill with sand. This destroyed the clam grounds, the blue crab population, and other wildlife habitat.

2. What I propose is to complete the present plan to establish geotubes at the break in the dike, and while the dredge is in place, establish some endangered bird resting and nesting habitat. These birds require protection from dogs and foxes and also from people who can't read the signs.

3. When the dredge is in Barnegat Inlet and needs to dispose of sand, it could well be placed on the previous bird nesting area on the south side of the south jetty. In the past this resulted temporaily in a favored nesting areas for terns, piping plovers, and skimmers, but the subsequent weed and grass growth has almost eliminated any bird use.

4. Mud Channel which runs around the western tip of Sedge Island and connects Oyster Creek Channel was the main access to Barnegat Inlet for boats coming down the east side of the bay. As a result of the force of the water changing, the mouth of this channel has filled with sand and only small boats on a high tide can use this channel because of it. There is no question that reestablishing this channel would result in a major flow of tide into the east side of the bay, where over 3,000 acres of the best eelgrass is growing. The fill from the Mud Channel dredging could be pumped onto the marsh at Sedge Island, which has been used in the past for maintenance dredging in the 1960's. At present this marsh is almost worthless to wildlife as Phragmites has taken over. This could be turned into a fine tern, piping plover, and skimmer colony without fear of dogs and foxes and public interference. This would need to be coordinated with the Division of Fish, Game and Wildlife.

5. There are two small islands created for pumping sand from the Oyster Creek Channel for a number of years. Initially, they provided excellent nesting habitat for colonial beach nesting birds. Small bulldozers could easily scrape off a foot of these islands which would remove the heavy stand of beach grass and Phragmites and restore the productivity of these island. They could be established as more or less

permanent disposal areas for maintenance dredging of the Oyster Creek Channel, which is the primary boat channel. These dredge spoil areas could become nesting areas for beach nesting and endangered birds, but continue to be disposal sites.

6. I feel it's essential to follow the eelgrass growth and development on an annual basis. As you know, when I was with the State Division of Fish and Game, a biologist, I mapped the Barnegat Bay eelgrass beds in 1968 and 1969.

Between 1995 and 1999 I mapped the eelgrass by boat on all of Barnegat Bay under small grants from the Barnegat Bay Estuary Program. I studied growth of the undisturbed eelgrass meadows, the effect of boat propellers and hand cutting on eelgrass, and regrowth. I discovered "wasting disease" in Barnegat Bay in 1995 which is caused by a Protist (Labryinthula zosterea). Also, I identified five major macro algae which smothered the eelgrass in several major areas of the bay.

I plotted the eelgrass using GPS numbers on the work map and Rick Laythrop digitized the locations to calculate the acreages of eel and widgeon grass.
As a result of the unusually warm bay water in 1998 and 1999, several species of algae flourished in the northern quarter of Barnegat Bay and destroyed a high percentage of the grass growth. This spring I plan to remap this area and Dr. Laythrop may correct the present eelgrass locations in the bay. The present map does not reflect the loss of SAV beds in 1998 and 1999. As the DEP, the U.S. Fish and Wildlife Service, the Corps of Army Engineers, county and local planning boards and individuals use these maps for management and permit purposes, it's important to keep them current. One of the points I would like to make is that if we are serious about protecting the SAV meadows and the dependent wildlife, it's essential that the Barnegat Bay eelgrass be looked at every year to determine if there may be a disease, waterfowl, freezing, algal growth, human interference by clam dredging and shrimping or other decimating factors. From my observations for 50 years I have noted that Barnegat Bay is not a static habitat, but one which is subject to many known and unknown causes. The SAV is probably the best indicator of the health of Barnegat Bay. When the SAV begin to die off, or appear unhealthy, there is something wrong in the water in which it lives

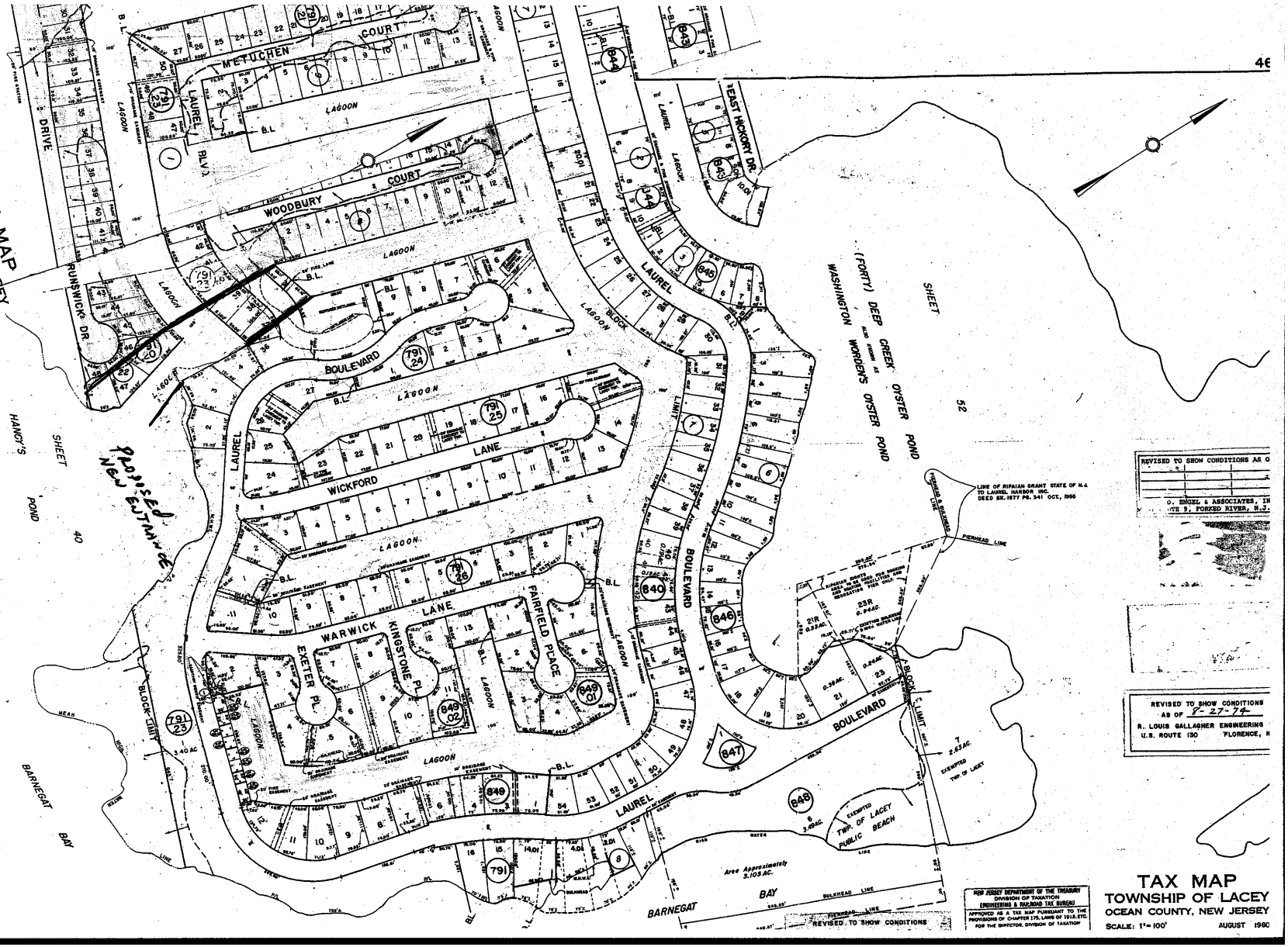
.

I hope this information is of value in your deliberations. If you can substitute this letter for the 3 by 5 inch card I filled out yesterday, it would easier for the reader to understand.

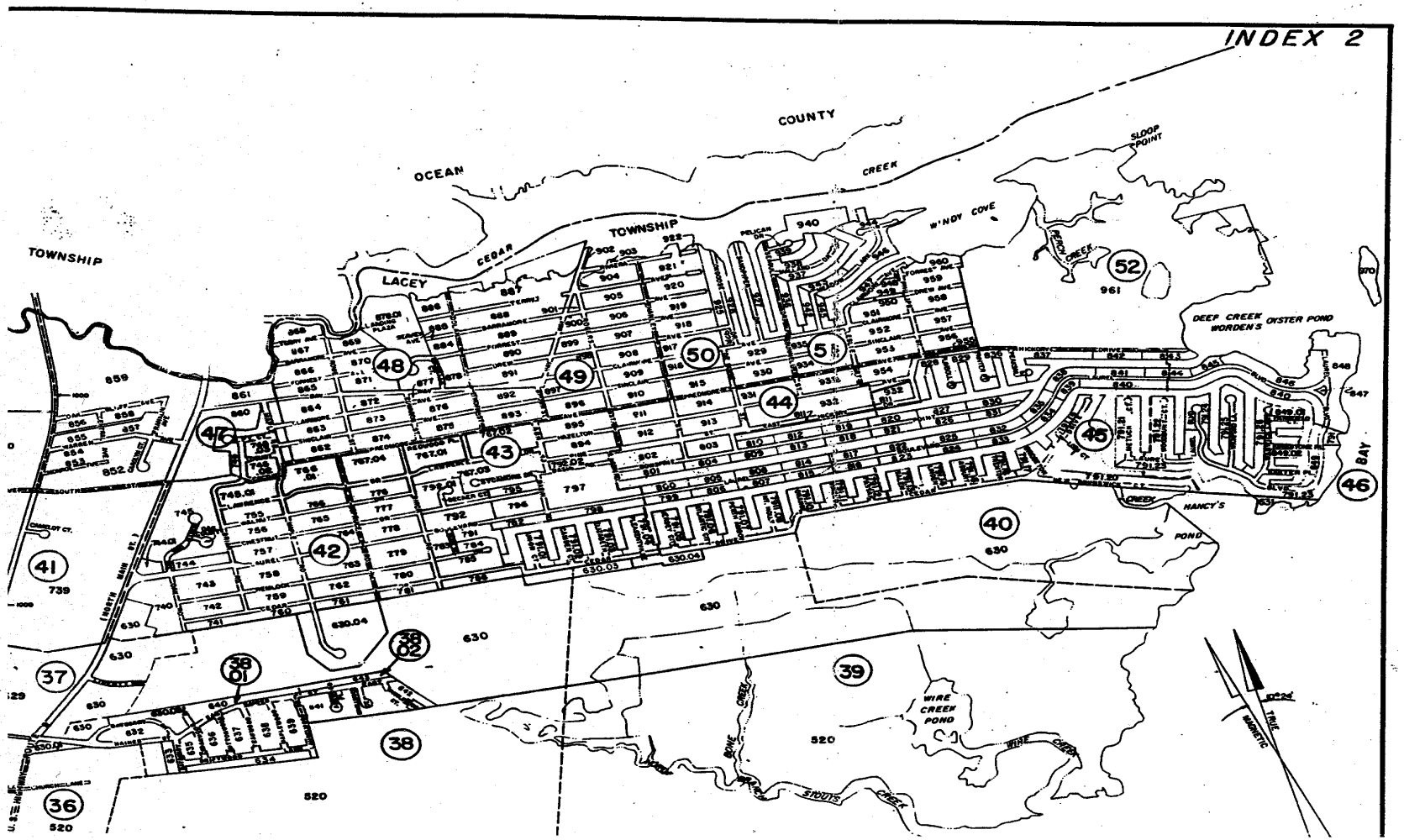
Best regards,

Pete

Paul "Pete" McLain
Consultant


TAX MAP
TOWNSHIP OF LACEY
COUNTY, NEW JERSEY
AUGUST 1960
DIRECTOR
SHEET 40
HANCY'S POND
BARNEGAT BAY
MEAN
BLOCK LIMIT
RUNSWICK DR.
DRIVE
METUCHEN COURT
LAUREL BLVD.
WOODBURY COURT
LAGOON
B.L.
BOULEVARD
WICKFORD LANE
WARWICK LANE
EXETER PL.
KINGSTONE PL.
FAIRFIELD PLACE
LAUREL BOULEVARD
EAST HICKORY DR.
(FORTY) DEEP CREEK OYSTER POND
ALSO KNOWN AS
WASHINGTON WORDEN'S OYSTER POND
SHEET 52
LINE OF RIPARIAN GRANT STATE OF N.J. TO LAUREL HARBOR INC. DEED BK. 1877 PG. 341 OCT., 1956
PIERHEAD LINE
BULKHEAD LINE
EXEMPTED TWP. OF LACEY PUBLIC BEACH
Area Approximately 3.103 AC.
Proposed New Estimate
REVISED TO SHOW CONDITIONS
REVISED TO SHOW CONDITIONS AS OF 8-27-74
R. LOUIS GALLAGHER ENGINEERING
U.S. ROUTE 130 FLORENCE, N.J.
NEW JERSEY DEPARTMENT OF THE TREASURY
DIVISION OF TAXATION
ENGINEERING & RAILROAD TAX BUREAU
APPROVED AS A TAX MAP PURSUANT TO THE PROVISIONS OF CHAPTER 175, LAWS OF 1918, ETC.
FOR THE DIRECTOR, DIVISION OF TAXATION
TAX MAP
TOWNSHIP OF LACEY
OCEAN COUNTY, NEW JERSEY
SCALE: 1" = 100'
AUGUST 1960

INDEX 2


COUNTY
OCEAN
CREEK
TOWNSHIP
TOWNSHIP
LACEY
CEDAR
SLOOP POINT
WINDY COVE
PEACH CREEK
DEEP CREEK WORDEN'S OYSTER POND
HANCY'S POND
WIRE CREEK POND
WIRE CREEK
STOUTS CREEK
BAY
TRUE
MAGNETIC
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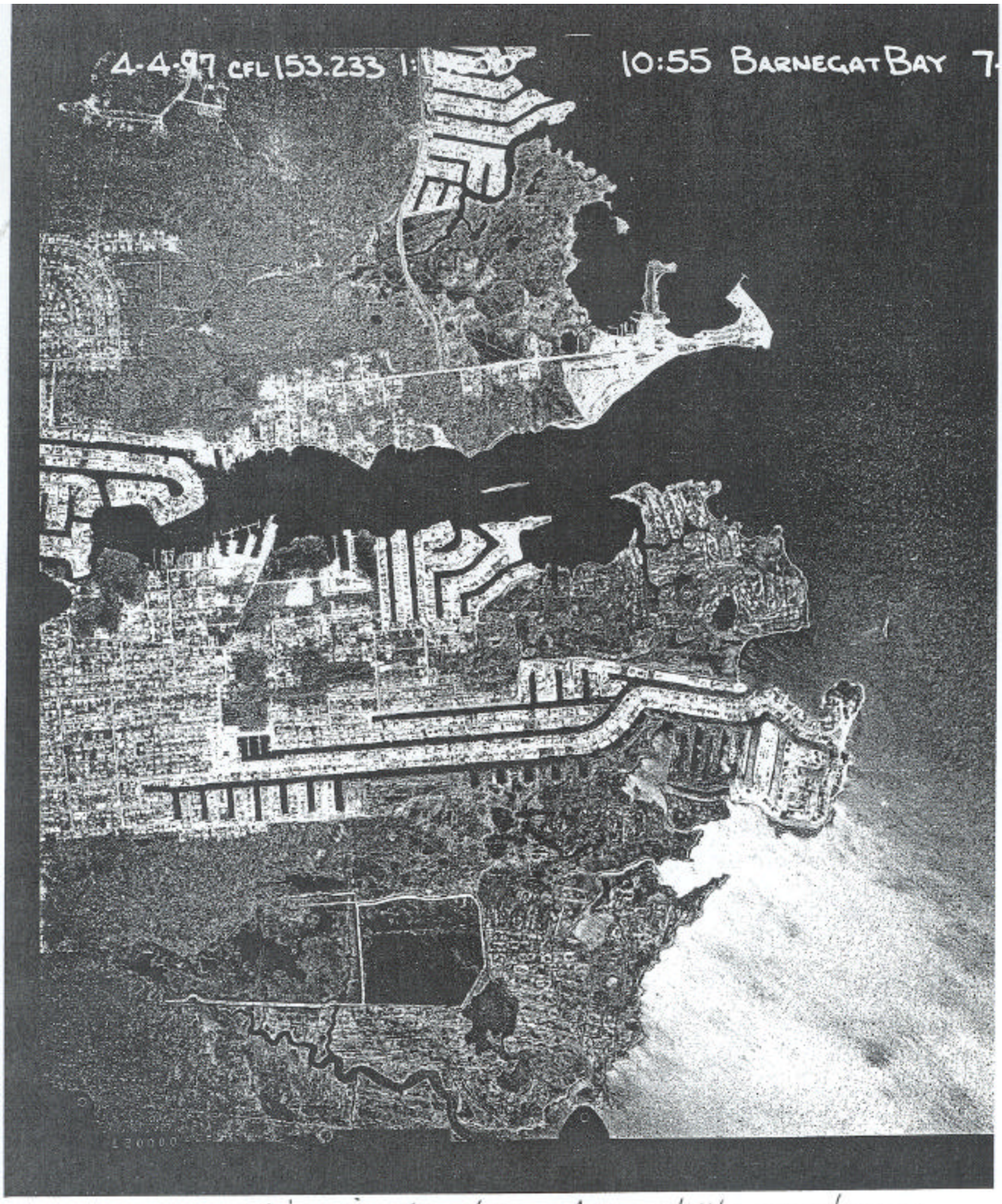


I put this in the pkg. for a little assistance in locating geographically. Terry F.

From: Dave Jenkins <DJENKINS@dep.state.nj.us>
To: <harriottste@versar.com>
Date: 1/31/00 3:08PM
Subject: Barnegat Bay Ecosystem Restoration Projects

Steve,

It was good to meet you last week and see what is going on with the Barnegat Bay Ecosystem Restoration Project. As I mentioned, many of the islands in the Barnegat Bay -- Little Egg Harbor area are used by colonial nesting waterbirds including long-legged wading birds on islands with woody vegetation and gulls, common terns, Forster's terns and black skimmers on islands with either sandy areas or high wrack deposits.

We would be very interested in evaluating habitat enhancement and restoration possibilities on these islands. Projects would probably involve vegetation manipulation of some type, e.g., removing vegetation to enhance habitat for terns and skimmers or planting woody vegetation to enhance habitat for long-legged wading birds. Logistically, I'm sure the easiest to deal with would be islands containing existing dredge disposal sites.

As I have not visited most of the islands in the past several years, we would need to have a look at each one before making specific recommendations. I gather that you may be on a tight time schedule so that visiting each island by boat may be out of the question (we would have to wait for the ice to clear, at least). In the past we have been able to get the Ocean County Mosquito Commission to fly us in one of their helicopters for projects such as this. I could pursue this if you thought it would be worthwhile. Let me know.

Here is a list of Barnegat Bay Islands that have been used by colonial nesting waterbirds in the past or appear to be amenable to habitat enhancement (bolded sites are those that, on first guess, have the greatest potential).

Several islands in the "Story Island" area
Middle Sedge Is.
Shelter Is.
Little Is.
Mordecai Is.
Marshelder Islands (e & w)
Ham Islands (e & w)
Flat Is.

Egg Is.
Cedar Bonnet Is.
Pettit Is.
Vol Sedge Is.
Highbar Is.
Oyster Creek "dredge islands" (these are two sandy dredge material islands along Oyster Creek channel created by disposal operations over the past ~10 years).
Several unnamed islands north of the Mathis Bridge (Rt. 37).

We are also very interested in habitat improvement/restoration of a large section of beach at the northern tip of Barnegat Light. This would involve vegetation removal/control in an area ~12 acres that has become too vegetated for use by common terns, black skimmers and piping plovers that used to nest there.

Please keep me informed, especially regarding any projects targeted at colonial waterbirds.

Thanks.

Dave Jenkins
Principal Zoologist
New Jersey Div. of Fish and Wildlife
Endangered and Nongame Species Program
P.O. Box 400
Trenton, NJ 08625-0400
609.984.1581
fax. 609.984.1414

Versar INC.

Telephone Conversation Record

with: Dave McKeon, Ocean County Planning Department
phone #: 732/929-2054
date: 2/25/00
time: 12:30
account: 4033-027

Conversation Summary:

Dave called Mark Southerland and left a message (which Mark forwarded to me). Dave's message stated that his office does not have any sites to formally recommend for restoration. He met with the Natural Lands Committee several days ago and they also do not have an sites to suggest for restoration activities.

From the desk of...

A. Morris Perot, Jr.
Environmental Scientist
Versar, Inc.
9200 Rumsey Rd.
Columbia, MD 21045

Direct Line: 410-740-6092
Switchboard: 410-964-9200
Fax: 410-964-5156
Email: perotmor@versar.com

F:\DATA\USERS\Perotmor\Phila. COE\Barnegat Site Selection\Dave McKeon telecon.wpd

APPENDIX 4

Public Workshops and Committee Meetings Attendance Lists

Public Meeting Attendance Lis

Last Name	First Name	Organization	Work Phone	1/24/00 4pm	1/24/00 7pm	2/15/00 BBEP	2/23/00 4pm	2/23/00 7pm	3/21/00 BBEP
Anderson	Angela		(609) 294-3111	☐	☐	☑	☐	☐	☑
Bennett	Diane	Island Beach State Park	(732) 793-1698	☑	☐	☐	☑	☐	☐
Bologna	Paul	Rutgers University	(609) 696-5260	☑	☐	☐	☐	☐	☐
Boyle	John F.	Forked River Mountain Coalition	(609) 242-3042	☐	☑	☐	☐	☐	☐
Brady	John	USACE - Phila. Dist., Env. Resources	(215) 656-6555	☑	☑	☑	☑	☑	☐
Browne	Malcolm	GPU Nuclear	(609) 971-4124	☐	☐	☐	☐	☐	☑
Burrowes III	Paul		(609) 971-7192	☐	☑	☐	☐	☐	☐
Burton	William	Versar, Inc.	(410) 740-6086	☑	☑	☐	☐	☐	☐
Butow, Jr.	Paul E.	Borough of Ocean Gate		☑	☐	☐	☑	☐	☐
D' Ascoli	Heidi	c/o Ocean County Planning Board	(732) 506-5313	☐	☐	☐	☐	☐	☑
Dantoni	Maria & Anthony		(609) 242-0335	☐	☑	☐	☐	☐	☐
DeFranco	Gary	United Environmental Services	(856) 227-5477	☑	☐	☐	☐	☐	☐
DeLeonard	Bob	NJ Beach Buggy Assoc.	(732) 793-8080	☑	☐	☐	☑	☐	☐
Dello-Russo	Larry	Newport Bay Club Homeowners Assoc	(609) 693-5185	☐	☑	☐	☐	☐	☐
Dello-Russo	Kathleen		(609) 693-5185	☐	☑	☐	☐	☐	☐
DeLuca	Michael	Rutgers University, IMCS	(732) 932-6555	☐	☐	☐	☐	☐	☑
Dieterich	Bob	USEPA Region II Estuaries & Oceans	(212) 637-3794	☐	☐	☑	☐	☐	☑
Doyle	Martha A.	Clean Ocean Action	(609) 294-8040	☑	☐	☑	☐	☐	☐

Last Name	First Name	Organization	Work Phone	1/24/00 4pm	1/24/00 7pm	2/15/00 BBEP	2/23/00 4pm	2/23/00 7pm	3/21/00 BBEP
Evenson	Eric	USGS, WRD	(609) 771-3901	☐	☐	☑	☐	☐	☐
Filardi	Patrick		(609) 693-2567	☐	☑	☐	☐	☐	☐
Fiorile	Robert R.	Environmental Design Group	(732) 477-3203	☑	☐	☐	☐	☐	☐
Flimlin	Gef	NJ Sea Grant Marine Advisory Service	(732) 349-1152	☐	☐	☐	☑	☐	☐
Fote	Tom			☐	☐	☐	☑	☐	☑
Fowler	Terry	USACE - Phila. Dist., Coastal Planning	(215) 656-6575	☑	☑	☑	☑	☑	☑
Gaudini	Paul	USACE - Phila. Dist., Planning Branch		☑	☑	☐	☐	☐	☐
Giambattista	Horrace	Fish Hawk Fishing Club	(609) 971-7184	☑	☐	☐	☐	☐	☐
Griber	Penny	D.W. Smith Assoc.	(732) 363-5850	☐	☐	☑	☐	☐	☑
Hammarstrom	Bill		(609) 693-4281	☑	☐	☐	☐	☐	☐
Harriott	Steve	Versar, Inc.	(410) 740-6099	☑	☑	☐	☐	☐	☑
Hempstead	William		(609) 693-4132	☑	☐	☐	☐	☐	☐
Henry	Ed	USFWS	(609) 646-9310	☐	☐	☐	☐	☐	☑
Hoefling	Marie		(609) 971-0019	☐	☑	☐	☐	☐	☐
Hoefling	Kane		(609) 693-5508	☐	☑	☐	☐	☐	☐
Johnson	Pat		(609) 494-5900	☑	☐	☐	☐	☐	☐
Kennish	Mike	Rutgers Inst. of Marine & Coastal Sci.	(732) 932-8959	☐	☐	☐	☐	☐	☑
Kessler	Ted		(609) 693-3887	☑	☐	☐	☐	☐	☐
Koons	Joan		(609) 492-5306	☐	☐	☐	☑	☐	☑
Kunze	Richard C.	Ocean County Utilities Authority	(732) 269-4500	☐	☐	☐	☐	☐	☑

Last Name	First Name	Organization	Work Phone	1/24/00 4pm	1/24/00 7pm	2/15/00 BBEP	2/23/00 4pm	2/23/00 7pm	3/21/00 BBEP
Lacey	Hon. Jim		(732) 929-2004	☐	☐	☐	☐	☐	☑
LaMacchia	John		(732) 270-9360	☐	☐	☑	☐	☐	☑
Larson	Jan	Rutgers Cooperative Extension	(732) 505-3671	☑	☐	☐	☐	☑	☐
McCarthy	Peter		(609) 978-0415	☐	☐	☐	☑	☐	☐
McKeon	Dave	Ocean County Planning Board	(732) 929-2054	☐	☐	☐	☐	☐	☑
McLain	Paul "Pete"		(832) 349-6418	☑	☐	☐	☐	☐	☐
Moni	Rudy		(732) 270-1830	☐	☑	☐	☐	☐	☐
Nicholson	Robert	USGS	(609) 771-3925	☐	☐	☐	☐	☐	☑
Palumbo	Russ	Lacey Twp.	(609) 693-1100	☑	☐	☐	☐	☐	☐
Perot	Morris	Versar, Inc.	(410) 740-6092	☑	☑	☑	☑	☑	☐
Reid	Janice	USDA, NRCS	(732) 462-1079	☐	☐	☑	☐	☐	☐
Rinderer	Sandra		(732) 341-0838	☑	☐	☐	☐	☐	☐
Rizzo	Joe	N.J. Shellfisheries Assoc.	(609) 597-1347	☐	☑	☐	☐	☐	☐
Rollwagen	Janice	Estuaries & Oceans Section	(212) 637-3778	☐	☐	☑	☐	☐	☑
Rosenblatt	Dave	NJDEP - DWM	(609) 984-6860	☐	☐	☑	☐	☐	☑
Sarrett	Martin & Ruth		(732) 295-7975	☐	☑	☐	☐	☐	☐
Schwanit	Margot	NDJEP		☐	☐	☐	☐	☐	☑
Scro	Bob	NJDEP, OEP	(609) 633-2003	☐	☐	☐	☐	☐	☑
Sinnema	Michael S.	Environmental Design Group	(732) 477-3203	☑	☐	☐	☐	☐	☐
Southerland	Mark	Versar, Inc.	(410) 740-6074	☑	☑	☑	☑	☑	☑

Last Name	First Name	Organization	Work Phone	1/24/00 4pm	1/24/00 7pm	2/15/00 BBEP	2/23/00 4pm	2/23/00 7pm	3/21/00 BBEP
Spencer	Roseanne		(609) 242-2820	☐	☑	☐	☐	☐	☐
Spiecberger	Fred		(609) 693-6233	☐	☑	☐	☐	☐	☐
Terpanick	Patricia			☑	☐	☐	☐	☐	☐
Thane	Henry			☑	☐	☐	☐	☐	☐
Tomasi	Joseph V.		(732) 864-9757	☑	☐	☐	☐	☐	☐
Vibbert	William	NJ State Park Service		☑	☐	☐	☐	☐	☐
Wagner	Dawn & Eric		(732) 892-0945	☐	☑	☐	☐	☐	☐
Walnut	A. Jerome			☐	☐	☐	☑	☐	☐
White	Jim		(609) 693-6320	☐	☑	☐	☐	☐	☐
Wolff	Henry		(732) 349-4931	☑	☐	☐	☐	☑	☐
Wolff	Anne		(732) 349-4931	☑	☐	☐	☐	☑	☐
Zappile	Carmen	USACE - Phila. Dist., Coastal Planning		☐	☐	☐	☑	☑	☐

APPENDIX B

FIELD DATA SHEETS

(Included on Accompanying CD)

(ISS01)

1

CHANGE NAME TO M8

Barnegat Bay Watershed Analysis
Wetland Site Data

(MEAS M8/P5)

Location ID/Name: PRE13 (CEDAR BONNET) **Date:** NOV. 29, 1999
GPS Coordinates: RECORDED (PRE13) **Crew:** Harriott, Cole
Photo Rolls/Frames: ROLL #1

Project Type(s): (circle all that are appropriate)
a) *Phragmites* removal b) fill removal c).tidal re-establishment
d) creation e) structure addition/removal f) other (describe below)

Project/Site Description: REMOVE PHRAG. FROM LARGE PART OF THE ISLAND, AND ADD SANDY DREDGED MATERIALS TO CREATE NESTING BIRD HABITAT. PRESERVE SMALL STANDS OF DECIDUOUS TREES. AND TERRAPIN HABITAT

Landownership: USFWS/FORSYTHE

If fill, is it an outstanding violation with the USACE or NJDEP: N/A

Present Land Cover/Uses (on and off-site): NEXT TO CAUSEWAY PHRAGMITES/BAYBERRY/DECIDUOUS TREES

Dominant Vegetation: PHRAG., BAYBERRY, POPULUS DELTOIDES, POISON IVY, PRUNUS, RUBUS

Approximate Area of Proposed Site: ≈ 112 ACRES

Approximate Quantity of Excavation Required (acre-feet): N/A

Construction Access: a). limited b). moderate c). accessible **Description:**

Structures Required/Describe: N/A

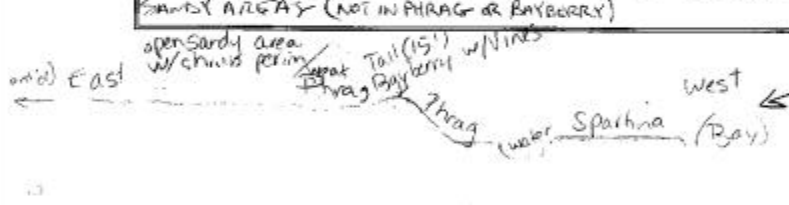
Presence of Utilities: NONE

Side Slope of Existing Site: 1% TO 5%

Hydrology Input to Existing Site: BARNEGAT BAY (SITE IS CURRENTLY PRIMARILY UPLAND)

Receiving Stream/Water Body:
BARNEGAT BAY
39° 39' 25.85517" N
74° 11' 43.26075" W

Notes and Sketches: SIGNS OF RACCOONS PRESENT. DIAMONDBACK TERR. SCRAPES. Opportunity for wildlife viewing, Predator exclusion required for nesting birds. HEAVY COVER OF PHRAGMITES ON PARTS OF WEST SIDE. APPEARS TO BE MANY TURTLE SCRAPES THROUGHOUT IN ANY OF THE OPEN SANDY AREAS (NOT IN PHRAG OR BAYBERRY)



NOTE: ALSO VISITED SITE FROM BOAT ON 22 DECEMBER. LANDED ON W SIDE AND TRIED TO FIND SMALL POND, BUT OBSCURED BY PHRAG. NOTED HEAVY PHRAG COVER AND NUMEROUS TURTLE SCRAPES ALONG (SANDY) PATHWAY.

ISS02

23

Barnegat Bay Watershed Analysis
Waterbird Habitat Restoration

Location ID/Name: FLAT ISLAND **Date:** 6 DEC, 1999
GPS Coordinates: 39°37.9702/74°11.7720 **Crew:** PHIL/STEVE
Photo Rolls/Frames: ROLL #6

Project Type:	a) *Phragmites*/vegetation removal b) placement of dredged materials c) island expansion/creation d) other (describe below)
Project/Site Description:	FLAT ISLAND – REMOVE PHRAG & DEPOSIT NEW MATERIALS TO CREATE A SANDY ISLAND. SMALL AREAS CONTAINING TREES & SHRUBS MUST BE PRESERVED.
Landownership:	STATE
Present Land Cover:	PHRAG / DREDGE DISPOSAL
Are Wetlands Present? Y/N Describe:	
Approximate Area of Proposed Site:	50 ACRES ?
Approximate Quantity of Fill Material Required (acre-feet):	SEVERAL FEET OVER PARTS OF SITE
Site Access for Boats - Are Shallows Present? Describe:	YES, GOOD. WE LANDED ON EAST SIDE
Birds Observed at or Directly Adjacent to Site:	COLONIAL NESTERS (A FEW NESTS IN TREES)
Birds Likely to use Restored Site:	HERONS, EGRETS & BEACH NESTERS
SAV Currently Present in Vicinity of Site? Y/N Describe:	

Notes and Sketches

SOME NESTS IN TREES (BAYBERRY/IVA). SPARTINA MARSH ON S. SIDE OF ISLAND. CHECK RECENT AERIALS FOR MAPPING OF TREES. NW PART OF ISLAND USED MOST RECENTLY FOR DREDGE. SOME TIDAL MARSH ON N AND S ENDS OF ISLAND. SOME MAN-MADE 'SHADING' STRUCTURES PRESENT.

ISS03

#24

Barnegat Bay Watershed Analysis
Waterbird Habitat Restoration

Location ID/Name: HIGH ISLAND **Date:** 6 DEC. 1999
GPS Coordinates: 39° 37.4348 / 74° 16.2290 **Crew:** PHIL / STAVE
Photo Rolls/Frames: ROLL #6

Project Type:	a) *Phragmites*/vegetation removal b) placement of dredged materials (POSSIBLE) c) island expansion/creation f) other (describe below)
Project/Site Description:	REMOVE PHRAG & OTHER VEG. FROM ISLAND. PLACE DREDGED MATERIALS AS NEEDED (MIGHT NOT NEED)
Landownership:	STATE
Present Land Cover:	PHRAG (ALL RELATIVELY FLAT) w/ SOME BAYBERRY, RED MAPLE, PI
Are Wetlands Present?	Y/N **Describe:** ↳ AROUND S END (POSSIBLE OTHER SIDES)
Approximate Area of Proposed Site:	15 ACRES (?)
Approximate Quantity of Fill Material Required (acre-feet):	UNKNOWN (MAYBE NONE)
Site Access for Boats - Are Shallows Present?	**Describe:** YES - EAST SIDE OF ISLAND
Birds Observed at or Directly Adjacent to Site:	NONE
Birds Likely to use Restored Site:	TERNS, SKIMMERS
SAV Currently Present in Vicinity of Site?	Y/N **Describe:** EELGRASS ON E SIDE
Notes and Sketches	RELATIVELY FEW WOODY PLANTS/TREES PRESENT - NO COLONIAL NESTING OBSERVED - SOME DENSE AREAS OF SAV PRESENT OFF E SIDE *- NOTE: VISITED HAM ISLAND - POSTED AS THE HABITAT (STATE RESERVE). SOME PHRAG - IS IT CURRENTLY MANAGED? (TAE MB)

*- EAST CONTINUOUS EDGE PART OF MARSHELDER ISLAND HAS VERY THICK AREAS OF PHRAGMITES - SMALL REMOVAL PROJECT.

*- PARKERS ISLAND - SMALL, GOOD POTENTIAL PHRAG REMOVAL PROJECT
39° 33.96 / 74° 14.92
- APPEARS TO BE DREDGE ISLAND

ISS04

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: STORY ISLAND **Date:** 6 DECEMBER 1999
GPS Coordinates: NOT RECORDED **Crew:** STEVE/PHIL
Photo Rolls/Frames: ROLL #7

Project Type(s): (circle all that are appropriate)
a) *Phragmites* removal b) fill removal c).tidal re-establishment
d) creation e) structure addition/removal f) other (describe below)

Project/Site Description: NEW DREDGE DISPOSAL FACILITY ON STORY ISLAND. NO OPPORTUNITIES OBSERVED HERE, EXCEPT FOR MINOR PHRAGMITES REMOVAL ON PERIMETER OF DIKES. VAST MAJORITY OF STORY IS NICE TIDAL MARSH.

Landownership: STATE/CORPS

If fill, is it an outstanding violation with the USACE or NJDEP: N/A.

Present Land Cover/Uses (on and off-site): - DISPOSAL AREA - NO VEG
- TIDAL MARSH

Dominant Vegetation: DIKES: BAYBERRY (PLANTED), PHRAGMITES, PANICUM DICHOTOMIFLORUM
TIDAL MARSH: SPARTINA ALTERNIFLORA, S. PATENS, DISTICHLIS SPICATA

Approximate Area of Proposed Site: DIKE

Approximate Quantity of Excavation Required (acre-feet): N/A

Construction Access: a). limited b). moderate c). accessible **Description:**
→ ACCESSIBLE FOR HAND-SPRAYING OF PHRAGMITES

Structures Required/Describe: N/A

Presence of Utilities: NONE

Side Slope of Existing Site: 15% TO 20% (?)

Hydrology Input to Existing Site: RAIN/PRECIP.

Receiving Stream/Water Body:
LITTLE EGG HARBOR

Notes and Sketches:
⇒ NOT MUCH OPPORTUNITY FOR PROJECT HERE, OTHER THAN PHRAGMITES REMOVAL, TO KEEP IT FROM SPREADING INTO THE RELATIVELY NICE TIDAL MARSH.

ISN05

#35

Barnegat Bay Watershed Analysis
Waterbird Habitat Restoration

Location ID/Name: STYRLING POINT **Date:** 21 DEC 1999
GPS Coordinates: 39°57.4746 N / 074°03.1127 W **Crew:** STEVE/PHIL/RATH
Photo Rolls/Frames: ROLL #9

Project Type: a) *Phragmites*/vegetation removal b) placement of dredged materials c) island expansion/creation d) other (describe below)

Project/Site Description: REMOVE PHRAG & OTHER VEG. FROM DREDGE DISPOSAL ISLAND. ADD LAYER OF SANDY MATERIALS FOR NESTING BIRDS. MAY BE A DIFFICULT SITE TO WORK WITH, GIVEN LOCATION OF EXISTING MARSH.

Landownership: STATE ?

Present Land Cover: UPLAND ISLAND / TIDAL MARSH

Are Wetlands Present? Y/N **Describe:** FW TIDAL MARSH

Approximate Area of Proposed Site: 8-10 ACRES OF UPLAND

Approximate Quantity of Fill Material Required (acre-feet): 20-30 ACRE-FEET

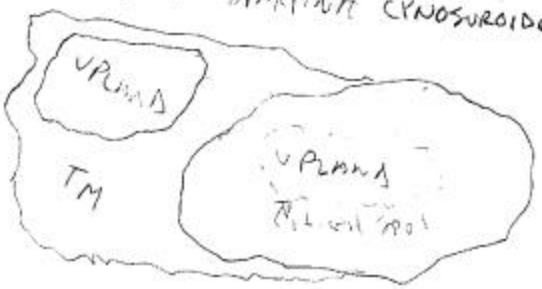
Site Access for Boats - Are Shallows Present? Describe: ACCESSIBLE (BOAT ONLY)

Birds Observed at or Directly Adjacent to Site: BLACK DUCKS, MALLARDS (OVERWINTER)

Birds Likely to use Restored Site: TERNS, SKIMMERS

SAV Currently Present in Vicinity of Site? Y/N **Describe:** → DIRNT OR SURVE (BUT PART TIME OF YEAR)

Notes and Sketches NOTE SPARTINA CYNOSUROIDES IS PRESENT HERE.



ISN06

3N 37

Barnegat Bay Watershed Analysis
Waterbird Habitat Restoration

Location ID/Name: HERRING ISLAND **Date:** 21 DECEMBER 1999
GPS Coordinates: 40°02.9920'/94°03.1480' **Crew:** STEVE/PHIL/KD
Photo Rolls/Frames: ROLL #10

Project Type: (a) *Phragmites*/vegetation removal (b) placement of dredged materials c) island expansion/creation f) other (describe below)

Project/Site Description: REMOVE PHRAG FROM 15-ACRE ISLAND. POSSIBILITY OF PUTTING SOME DREDGED MATERIALS ON TOP, BUT IF CURRENTLY SATURATED (I.E., WETLANDS)

Landownership: STATE

Present Land Cover: PHRAGMITES, W/SMALL AREAS OF BACCHARIS. VERY SMALL AREAS OF S. PATENS & S. CYNOSUROIDES

Are Wetlands Present? (Y)/N **Describe:** 99% PHRAG.

Approximate Area of Proposed Site: ~15 ACRES

Approximate Quantity of Fill Material Required (acre-feet): 2 TO 3 FEET, IF APPROPRIATE

Site Access for Boats - Are Shallows Present? Describe: YES - EASY LANDING

Birds Observed at or Directly Adjacent to Site: NO SIGNS - PHRAG TOO DENSE

Birds Likely to use Restored Site: VARIABLE

SAV Currently Present in Vicinity of Site? Y/(N) **Describe:** NOT CERTAIN (POTENTIAL)

Notes and Sketches

- NOTE - SIGNS OF PREDATORS (BIG SCATS ABUNDANT)

- TINY HIGH SPOT W/SASSAFRAS

=> OVERALL, NOT A GOOD ISLAND TO RESTORE

ISS07

3A 4b

Barnegat Bay Watershed Analysis
Waterbird Habitat Restoration

Location ID/Name: SANDY ISLAND **Date:** 21 DEC. 1999
GPS Coordinates: 39°42'8.200/074°08.8080 **Crew:** [illegible]
Photo Rolls/Frames: NO PHOTOS

Project Type:	a) *Phragmites*/vegetation removal b) placement of dredged materials c) island expansion/creation f) other (describe below)
Project/Site Description:	NO POTENTIAL PROJECT HERE – IS ALREADY NICE TIDAL MARSH (SPARTINA ALTERNIFLORA)
Landownership:	USFWS/ LEASED TO HUNTERS
Present Land Cover:	TIDAL MARSH
Are Wetlands Present? Y/N Describe:	Y/N ALL
Approximate Area of Proposed Site:	N/A
Approximate Quantity of Fill Material Required (acre-feet):	
Site Access for Boats - Are Shallows Present? Describe:	
Birds Observed at or Directly Adjacent to Site:	
Birds Likely to use Restored Site:	
SAV Currently Present in Vicinity of Site? Y/N Describe:	
Notes and Sketches	

(ISC08) #41

* NEW SITE

Barnegat Bay Watershed Analysis
Waterbird Habitat Restoration

Location ID/Name: #26A ISLAND **Date:** 21 DEC. 1999
GPS Coordinates: SAV RPT **Crew:** SCORE/RVM
Photo Rolls/Frames: ROLL # 10

Project Type: a) *Phragmites*/vegetation removal b) placement of dredged materials c) island expansion/creation f) other (describe below)	
Project/Site Description:	CREATE OPEN, SANDY HABITAT FOR BEACH NESTING BIRDS. REMOVE EXISTING PHRAG & OTHER VEG.
Landownership:	STATE
Present Land Cover:	PHRAG/SWITCHGRASS (ALL LOW) SOME OPEN SAND
Are Wetlands Present? Y/N Describe:	MARGINAL
Approximate Area of Proposed Site:	5 ACRES
Approximate Quantity of Fill Material Required (acre-feet):	10 AF (OR MORE)
Site Access for Boats - Are Shallows Present? Describe:	YES - SAND BARS MAKE ACCESS DIFFICULT - BE CAREFUL!
Birds Observed at or Directly Adjacent to Site:	LAUGHING GULLS, GREB GULLS
Birds Likely to use Restored Site:	SK. MERGS/TERNS
SAV Currently Present in Vicinity of Site? Y/N Describe:	→ SEE SAV STUDY

Notes and Sketches

- CHECK RECENT AERIALS FOR BREAKDOWN OF VEG VS. OPEN SAND
- ASK BRADY ABOUT STATUS OF DREDGE OP.

* - NOTE: VISITED THE ISLAND AGAIN ON 28 FEB. 2000 WITH JOHN BRADY & FSK. NOTED THAT FAIRLY LARGE AREAS OF ISLAND ARE BEING RE-COLONIZED BY PHRAGMITES. MANY GULLS (HERRING, LAUGHING, RING-BILLED, G. BLACK BACKED) WERE PRESENT. TWO OYSTERCATCHERS WERE PRESENT. TOOK PHOTOS & VIDEO FOOTAGE.

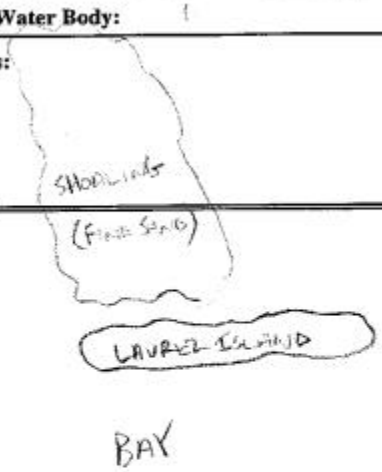
ISC09

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: LAUREL ISL
GPS Coordinates: RECORDED (LAUREL ISL)
Photo Rolls/Frames: #200

Date: 28 FEB 2000
Crew: SDH, FSIS, JB

Project Type:	a). *Phragmites* removal b). fill removal c). tidal re-establishment d). creation e). structure addition/removal f). other (describe below)
Project/Site Description:	VERY SMALL ERODED SITE W/EXTENSIVE SHOALING ON WESTERN SIDE. NOT MUCH CAN BE DONE HERE.
Present Land Cover/Uses (on and off-site):	TIDAL MARSH
Approximate Area of Proposed Site:	40 FT X 250 FT. (ISLAND ONLY)
Approximate Quantity of Excavation Required (acre-feet):	N/A
Construction Access: a). limited b). moderate c). accessible	**Description:** WATER ONLY
Structures Required/Describe:	N/A
Presence of Utilities:	N/A
Side Slope of Existing Site:	FLAT
Hydrology Input to Existing Site:	BARNEGAT BAY
Receiving Stream/Water Body:	" "
Notes and Sketches:	



(LA501)

8

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: M11 ("TWINE FORK" SITE) **Date:** 30 NOV. 1999
GPS Coordinates: RECORDED (M11) **Crew:** STEVE HARRIOT
Photo Rolls/Frames: ROLL #2

Project Type(s): (circle all that are appropriate)
a) *Phragmites* removal b) fill removal c).tidal re-establishment
d) creation e) structure addition/removal f) other (describe below)

Project/Site Description: LAGOON. (ONE EXISTING HOUSE)
→ NOT EXACTLY "ABANDONED." LOTS FOR SALE, BUT SIGNS VERY OLD.

Landownership: STATE (?) OR USFWS. IS DIRECTLY ADJACENT TO FORSYTHE NWR

If fill, is it an outstanding violation with the USACE or NJDEP: POSSIBLY

Present Land Cover/Uses (on and off-site): - ON SITE IS OPEN WATER W/ PHRAG ON EDGES (NARROW)
- OFFSITE IS GRASSY UPLAND
- FAR SIDE IS SPARTINA MARSH

Dominant Vegetation: ~~SPARTINA~~ PHRAG-SPARTINA

Approximate Area of Proposed Site: 180 FT WIDE X 500 FT LONG (≈ 2 ACRES)

Approximate Quantity of Excavation Required (acre-feet): N/A

Construction Access: a). limited b). moderate c). accessible **Description:**
→ PAVED ROAD & BY WATER

Structures Required/Describe: N/A

Presence of Utilities: PROBABLY ELECTRIC/SEWER/WATER TO SERVE EXISTING HOUSE

Side Slope of Existing Site: LAGOON IS DEEP

Hydrology Input to Existing Site: PARKERS RUN

Receiving Stream/Water Body:
DRAINS INTO PARKER'S RUN

Notes and Sketches:
*- ACCESS OFF SEA MEADOW DR. FROM ROUTE #9
- SEVERAL DOCKS IN DISREPAIR/IN WATER

15

NEW SITE (LAC02)

(Near M6)

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: BAYVILLE LAGOON
GPS Coordinates: RECORDED (BAYVILLELAG)
Photo Rolls/Frames: ROLL # 5

Date: December 2, 1999
Crew: Steve/Marlene

Project Type(s): (circle all that are appropriate)
a) *Phragmites* removal b) fill removal c) tidal re-establishment
d) creation e) structure addition/removal f) other (describe below)

Project/Site Description: Abandoned constructed lagoon and environs. Site has substantial fill in parts. Fill area borders spartina marsh along the Bay. Road present along filled area. Fill varies 3-15 ft.

Landownership: Ocean County Land Trust

If fill, is it an outstanding violation with the USACE or NJDEP: NOT CERTAIN

Present Land Cover/Uses (on and off-site): ROAD (DIRT), PILES OF FILL, TIDAL MARSH, OPEN WATER

Dominant Vegetation: Phrag., Switchgrass, Black cherry, Staghorn sumac, Juniper, Baccharis

Approximate Area of Proposed Site: 30 acres?

Approximate Quantity of Excavation Required (acre-feet): 3 acre feet (?)

Construction Access: a). limited b). moderate c). accessible **Description:** → DIRT ROAD

Structures Required/Describe: NONE

Presence of Utilities: None

Side Slope of Existing Site: VARIES, BUT PRIMARILY FLAT (SOME PILES PRESENT)

Hydrology Input to Existing Site: LAGOON IS CURRENTLY NOT DIRECTLY CONNECTED TO BAY

Receiving Stream/Water Body: BARNEGAT BAY

Notes and Sketches: lots of illegal dumping present at site. Lagoon edge is cut but has no bulkheading. Hunters use marsh down near the bay (duck blinds present). Fishing also occurs. Site could greatly benefit from fill removal, including the road. The site could also provide wildlife VIEWING, perhaps best accomplished by a boardwalk system (away from hunting area).

- PROVIDE ADDITIONAL FACILITIES FOR HUNTERS/FISHERMEN?

- NEW SITE

LAC03

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: BAYVILLE NORTH
GPS Coordinates: RECORDED (BAYVILLENORT)
Photo Rolls/Frames: ROLL #5
Date: 3 DECEMBER 1999
Crew: SIEVO/MARLOWE

Project Type(s): (circle all that are appropriate)
a) *Phragmites* removal b) fill removal c) tidal re-establishment
d) creation e) structure addition/removal f) other (describe below)

Project/Site Description: REMOVE/FILL ABANDONED LAGOON(S). TWO SEPARATE ADJACENT LAGOONS (MAY BE THREE). PUSH FILL BACK INTO LAGOONS, RE-GRADE & REMOVE PHRAGMITES, ASSESS/RE-ESTABLISH TIDAL CONNECTIONS TO MARSH!

Landownership: STATE (?) - AREA IS STILL TIDAL, WITHIN HIGH TIDE

If fill, is it an outstanding violation with the USACE or NJDEP: NOT KNOWN AT PRESENT (LIKELY)

Present Land Cover/Uses (on and off-site): - OPEN WATER - TIDAL MARSH - UPLAND SCRUB - ROAD

Dominant Vegetation: - PHRAGMITES - LONICERA JAPONICA - FIRE CHERRY - BLACK CHERRY - PITCH PINE - INKBERRY - BAYBERRY - AMERICAN HOLLY
MARSH: SPARTINA PATENS, DISTICHLIS SPICATA, PHRAGMITES

Approximate Area of Proposed Site: VERY LARGE (≈ 300 ACRES ?)

Approximate Quantity of Excavation Required (acre-feet): 100 FT (SIDE) X 10 FT. (DEEP) X 300 FT (LONG) = 30,000 CUBIC FEET / FOR EACH OF 2 LAGOONS

Construction Access: a). limited b) moderate c). accessible **Description:** SQUARE LAG. MAIN LAGOON IS MORE ACCESSIBLE, BUT STILL HAVE TO CROSS MARSH

Structures Required/Describe: NEW CULVERTS UNDER ROAD MAY BE APPROPRIATE

Presence of Utilities: GAS LINE ON S. SIDE OF BAYVIEW RD. MAY BE OTHERS.

Side Slope of Existing Site: 3:1 TO 4:1 ON FILL BANK

Hydrology Input to Existing Site: BOTH LAGOONS MAY BE CUT OFF FROM TIDE

Receiving Stream/Water Body: BARNEGAT BAY

Notes and Sketches: NEITHER OF THE 2 LAGOONS APPEAR TO BE DIRECTLY TIDALLY-CONNECTED. NO SIGNS POSTED FOR OWNERSHIP/TRESPASSING. ESTABLISH BETTER TIDAL CONNECTIONS ACROSS BAYVIEW ROAD - COMBINE WITH DIAMONDBACK TURTLE CROSSING FACILITIES, ESTABLISH PUBLIC BOARDWALKS INTERCONNECTED WITH BAYVILLE SOUTH LAGOON. MAY WANT TO CONSIDER BOTH BAYVILLE SITES AS 1 CONTIGUOUS SITE. (BAYVILLE NORTH & BAYVILLE LAGOON)

* ⇒ OF NOTE, WE OBSERVED A PITCH PINE ON TOP OF FILL APPROX. 25 YEARS OLD, PUTTING DATE OF CONSTRUCTION AT LATE 60's - EARLY 70's. CHECK HISTORIC AERIALS.

LAN04

28

Barnegat Bay Watershed Analysis
Restoration of Abandoned Lagoons

Location ID/Name: PRELIMINARY #1 **Date:** 7 DECEMBER 1999
GPS Coordinates: RECORDED (PRELIM1) **Crew:** STEVE
Photo Rolls/Frames: ROLL #7

Project Type(s): (circle all that are appropriate)
a) dike construction b) add/remove structures c) add fill for SAV
d) improve tidal circulation e) other (describe below)

Project/Site Description: ABANDONED LAGOONS. BOTH LAGOONS ARE FAIRLY NICE HABITAT - THE ONLY APPARENT PROJECTS RELATE TO IMPROVING EXISTING HABITAT (I.E., WOULDN'T MAKE SENSE TO FILL THEM IN). ONE OPTION WOULD BE TO PLANT SOME SAV IN BOTH (LARGER POND WOULD REQUIRE SOME FILL).

Land Ownership: USFWS (NOT POSTED, BUT IS AT LEAST ADJACENT TO FORSYTHE)

If fill, is it an outstanding violation with USACE or NJDEP: NOT KNOWN AT THIS TIME

Present Adjacent Land ~~Uses~~ COVER: FOREST, BAY, UPLAND MEADOW, TIDAL MARSH

Dominant Vegetation: FOREST: RED MAPLE, BLACK GUM, PITCH PINE MARSH: SPARTINA ALT., S. PATENS, DISTICHLIS

Approximate Area of Proposed Site: LARGE LAGOON: 1200 FT X 200 FT
SMALL LAGOON: 800 FT X 125 FT.

Structures Required/Describe: NONE

Average Water Depth at High Tide and Low Tide: LARGE: 10 FT. MAX
SMALL: 15 INCHES MAX

Approximate Quantity of Fill Required for SAV Establishment (acre-feet): * - CALCULATE FROM ABOVE

Site Access: **Boat Only? Y/N** a). limited b). moderate c). accessible
Description: SAND DIRT ROADS

SAV Currently Present? Y/N **Describe:**

Phragmites or Other "Nuisance" Species Present? Y/N **Describe:** VERY SMALL QUANTITIES - NOT A PROBLEM

Notes and Sketches:

ACCESS TO SITE WOULD BE EASILY DRIVEABLE IF BARRIER WAS REMOVED FROM OLD STP ACCESS ROAD, OR IF PILE OF YARD WASTE REMOVED FROM END OF RANDY'S LANE.

* - NOTED BELTED KINGFISHERS, RIVER OTTERS, RED FOX, SHARP SHINNED HAWK

60

~~BAN35~~
LAN05

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: 107A [& 107B]
GPS Coordinates: RECORDED (107A & 107B)
Photo Rolls/Frames: Roll # 102

Date: 18 Feb, 2000
Crew: SPH & KD

Project Type:	a). *Phragmites* removal b). fill removal c). tidal re-establishment d). creation e). structure addition/removal (f). other (describe below)
Project/Site Description:	TWO ABANDONED LAGOONS OFF ROUTE 528. POSTED WITHIN FORSYTHE REFUGE. TALL PILES OF EXCAVATED MATERIALS ON BOTH SIDES OF BOTH LAGOONS. FILL IN OR IMPROVE UPLAND HABITATS ADJACENT TO LAGOONS?
Present Land Cover/Uses (on and off-site):	FORSYTHE REFUGE
Approximate Area of Proposed Site:	200 ACRES (BOTH SITES COMBINED)
Approximate Quantity of Excavation Required (acre-feet):	NEED TO CALCULATE/PLAN
Construction Access:	a). limited b). moderate c). accessible → WATER ONLY **Description:**
Structures Required/Describe:	NONE
Presence of Utilities:	NONE
Side Slope of Existing Site:	FLAT TO 10% ON FILL PILES
Hydrology Input to Existing Site:	METEDECONK RIVER/BARNEGAT BAY (TOP POINT)
Receiving Stream/Water Body:	BARNEGAT BAY
Notes and Sketches:	PROJECT COULD COMBINE MARSH RESTORATION, UPLAND HABITAT IMPROVEMENTS, & TIDAL ELEMENTS. SOME PHRAGMITES IS PRESENT AT BOTH SITES. BOTH SITES ARE ADJACENT TO FAIRLY NICE TIDAL MARSH

HABITATS WITHIN FORSYTHE REFUGE, AND RESTORATION COULD INTEGRATE THESE SITES WITH THOSE HABITATS. BOTH LAGOONS APPEAR TO HAVE SANDY, UNIFORM BOTTOMS WITH DEPTHS OF ≈ 5 TO 6 FEET. NOT CLEAR AT THIS TIME WHETHER BOAT ACCESS IS CURRENTLY POSSIBLE. OBSERVED A FEW DUCKS @ 107B, BUT MOST BIRDS SEEM TO USE THE MARSH BEHIND THESE SITES.

~~TWN36~~
LAN06

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: 107B
GPS Coordinates: RECORDED (107B)
Photo Rolls/Frames: ROLL # 102

Date: 18 FEB. 2000
Crew: SPH & KD

Project Type:	**a). *Phragmites* removal b). fill removal c). tidal re-establishment d). creation e). structure addition/removal f). other (describe below)**
Project/Site Description:	SEE DESCRIPTION ON # 107A [LAN05] (PREVIOUS TO THIS SHEET)
Present Land Cover/Uses (on and off-site):	
Approximate Area of Proposed Site:	
Approximate Quantity of Excavation Required (acre-feet):	
Construction Access: a). limited b). moderate c). accessible	**Description:**
Structures Required/Describe:	
Presence of Utilities:	
Side Slope of Existing Site:	
Hydrology Input to Existing Site:	
Receiving Stream/Water Body:	
Notes and Sketches:	

NWS01

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Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: PRELIM #20/CEDAR RUN **Date:** 29 Nov. 1999
GPS Coordinates: CEDAR RUN **Crew:**
Photo Rolls/Frames: ROLL #1 SHOTS 1-7

Project Type(s): (circle all that are appropriate) a) *Phragmites* removal b) fill removal c).tidal re-establishment d) creation e) structure addition/removal f) other (describe below)	
Project/Site Description:	FORMER CRANBERRY BOG. THREE PARTIALLY BREACHED DIKES. ONE FUNCTIONING W.C. STRUCTURE (COULD EASILY BE REMOVED)
Landownership:	USFWS/FORSYTHE NWR
If fill, is it an outstanding violation with the USACE or NJDEP:	N/A
Present Land Cover/Uses (on and off-site):	NWR, PART OF THE FORSYTHE REFUGE
Dominant Vegetation:	- ERICACEOUS SHRUB, WATER-WILLOW - IN WATER - MIXED OAK FOREST - HWC FORESTS BORDERING ON TWO SIDES
Approximate Area of Proposed Site:	200 ACRES (?)
Approximate Quantity of Excavation Required (acre-feet):	1.5FT X 200 FT. X 3 DIKES
Construction Access: a). limited b). moderate c). accessible	**Description:**
Structures Required/Describe:	REMOVE DIKES & STRUCTURES, RESTORE STREAMBED
Presence of Utilities:	NONE OBSERVED
Side Slope of Existing Site:	FLAT. SMALL RIDGE TO W/SW.
Hydrology Input to Existing Site:	CEDAR RUN
Receiving Stream/Water Body:	CEDAR RUN
Notes and Sketches:	REMOVAL OF THE REMAINING WATER CONTROL STRUCTURE & THE TWO SMALL BERMS COULD RESTORE CEDAR RUN & ALLOW FOR RE-COLONIZATION OF AWC WETLANDS

NWS02

10

Barnegat Bay Watershed Analysis
Wetland Site Data

New Site
Location ID/Name: Stafford Forge WMA (STAFCRANB)
GPS Coordinates:
Photo Rolls/Frames: Roll 3
Date: 1 December 1999
Crew: Steve/Marlene

Project Type(s): (circle all that are appropriate)
a) *Phragmites* removal b) fill removal c).tidal re-establishment
d) creation (e) structure addition/removal f) other (describe below)

Project/Site Description: Chain of former cranberry bogs at the upper end of Westecunk Creek - SEVERAL OF THESE PONDS ARE LARGE AND ARE ESSENTIALLY JUST OPEN H2O PONDS, SURPRISINGLY FEW WATERFOWL OBSERVED ON PONDS.

Landownership: STATE (WMA) ADJACENT TO BASS RIVER SF

If fill, is it an outstanding violation with the USACE or NJDEP: probably too old for violation

Present Land Cover/Uses (on and off-site): Filled and drained bogs of variable size in mixed oak - Pitch Pine Forest criss crossed with numerous dirt roads.

Dominant Vegetation: Mixed oaks + Pitch Pine forest; Chamaecyparis in spots (dead stands in re-wetted bog); Gluceria obtusa, Dulichium sp., Juncus canadensis, Eriophorum sp. vaccinium, Carexsp. in drained bog.

Approximate Area of Proposed Site: 200 acres ?

Approximate Quantity of Excavation Required (acre-feet): NOT KNOWN (VARIABLE, BUT A LOT)

Construction Access: a). limited b). moderate c). accessible **Description:**
Many sturdy dirt roads.

Structures Required/Describe: N/A

Presence of Utilities: None

Side Slope of Existing Site: Flat - 2%

Hydrology Input to Existing Site: Westecunk Creek

Receiving Stream/Water Body: Westecunk Creek / Little Egg Harbor / B. Bay

Notes and Sketches:
Possibly consider restoring the lower Westecunk system for anadromous fishes and other ecological function.

* => RE-VISITED THIS SITE ON 18 FEBRUARY 2000 TO LOOK AT MAIN H2O - CONTROL STRUCTURE ON WESTECUNK CREEK. TOOK PICTURES & VIDEOS.

NWS03

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NEW SITE

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: Westecunk Creek: Silver Lake
GPS Coordinates: RECORDED (SILVER LAKE?)
Photo Rolls/Frames: Roll 3
Date: 1 December 1999
Crew: Steve / Marlene

Project Type(s): (circle all that are appropriate)
a) *Phragmites* removal b) fill removal c).tidal re-establishment
d) creation e) structure addition/removal f) other (describe below)

Project/Site Description: REMOVE 100-YEAR OLD WATER DIVERSION STRUCTURES ON WESTECUNK CREEK. REMOVAL WOULD ALLOW FOR ANADROMOUS FISH PASSAGE UP TO STAFFORD FORGE WMA

Landownership: PRIVATE/STATE ?

If fill, is it an outstanding violation with the USACE or NJDEP:

Present Land Cover/Uses (on and off-site): Creek, PWC forest, Residential Neighborhood
Formerly Cranberry bogs (long ago).

Dominant Vegetation: Chamaecyparis, Clematis, Smilax, algae

Approximate Area of Proposed Site: structure is about 100' long (span), 25' wide.

Approximate Quantity of Excavation Required (~~acre-feet~~):

Construction Access: a). limited (b). moderate c). accessible **Description:** Silver Lake Road
Need to re-assess access for equipment

Structures Required/Describe: Remove Dam

Presence of Utilities: None

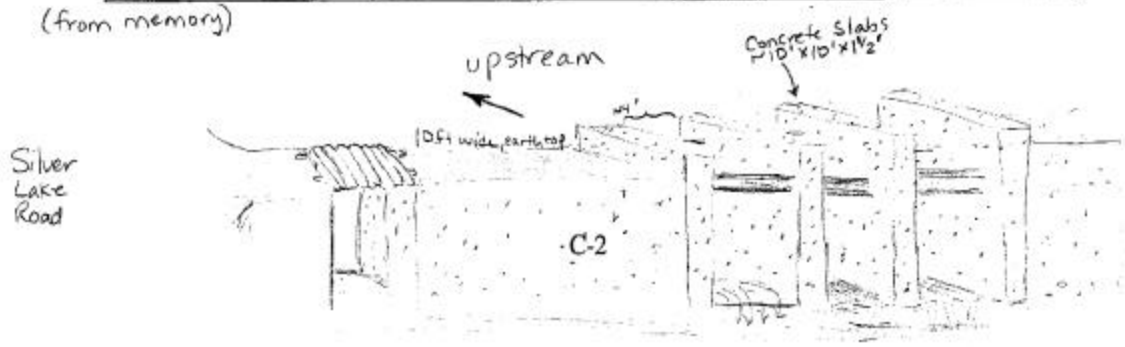
Side Slope of Existing Site: ~ 8-10% (30°)

Hydrology Input to Existing Site: Westecunk Creek

Receiving Stream/Water Body:
Westecunk Creek (Little Egg Harbor)

Notes and Sketches:
House next to site is purported to be the 2nd oldest (residence) house in Ocean County. The homeowner (who raises ducks) claims to own the land up to the creek. Area never floods (according to residents of 25 + 18 years) and never freezes.

(from memory)



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NWS04

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: P4 (Allen Rd.) **Date:** 12-01-99
GPS Coordinates: Record (P4) **Crew:** Steve / Marlene
Photo Rolls/Frames: Roll 4 (beg.)

Project Type(s): (circle all that are appropriate)
a) *Phragmites* removal b) fill removal c).tidal re-establishment
d) creation e) structure addition/removal f) other (describe below)

Project/Site Description: Open meadow where once was forested wetland.

Landownership: USFWS(?) PRIVATE

If fill, is it an outstanding violation with the USACE or NJDEP: If so, then probable violation

Present Land Cover/Uses (on and off-site): Grasses, forbs

Dominant Vegetation: [Broomsedge (Andropogon virginicus) – Panicum] [Soft rush (Juncus effusus) + Scirpus cyperinus] NW corner bushclover + broomsedge

Approximate Area of Proposed Site: 4 acres

Approximate Quantity of Excavation Required (acre-feet): 8 – 12

Construction Access: a). limited b). moderate c). accessible **Description:** Next to paved road (Allen Rd.), Dirt Rd

Structures Required/Describe: N/A

Presence of Utilities: Electrical on other side of Allen Rd, MCI fiber optic and sewer on dirt road

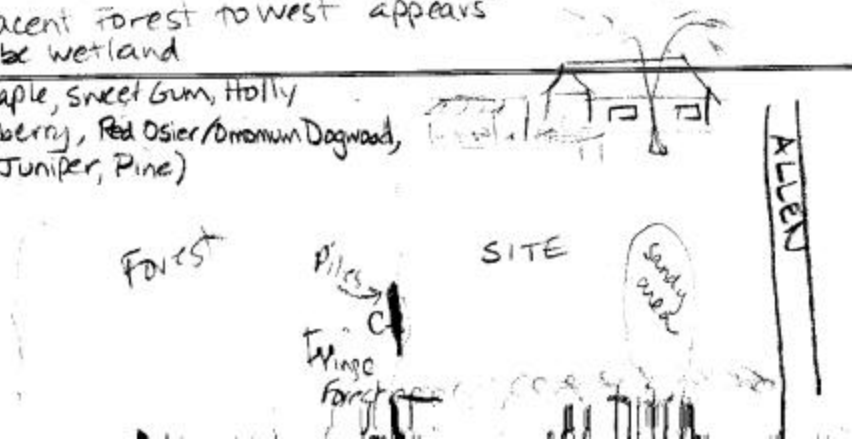
Side Slope of Existing Site: Flat

Hydrology Input to Existing Site: Surface, ground (?)

Receiving Stream/Water Body:
Cedar Run Creek / Little Egg Harbor

Notes and Sketches:
No tree stumps to be seen. No woody vegetation. Most of surface of soil is organic. Sprig of Phrag in middle. Adjacent forest to west appears to be wetland

(Red maple, Sweet Gum, Holly
HB Blueberry, Red Osier/Brownum Dogwood,
Smilax, Juniper, Pine)



NWN05

24 27

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: M3 **Date:** 7 DEC. 1999
GPS Coordinates: RECORDED (M3) **Crew:** STEVE
Photo Rolls/Frames: ROLL #7

Project Type(s): (circle all that are appropriate)
a) *Phragmites* removal b) fill removal c) tidal re-establishment
d) creation e) structure addition/removal f) other (describe below)

Project/Site Description: SITE CONTAINS AN OLD CRANBERRY BOG (NOW A SHALLOW POND). POND IS SURROUNDED BY UPLAND & WETLAND MIXED FOREST. PROJECT WOULD BE TO DRAIN POND TO ALLOW GROWTH OF ATLANTIC WHITE CEDAR COMMUNITY. VERY SMALL PROJECT OVERALL.

Landownership: PRIVATE (? - NOT SURE) - SITE IS NOT POSTED

If fill, is it an outstanding violation with the USACE or NJDEP: NOT KNOWN AT THIS TIME

Present Land Cover/Uses (on and off-site): - POND - WETLAND FOREST - UPLAND FOREST -

Dominant Vegetation: PITCH PINE, ATLANTIC WHITE CEDAR, CRANBERRY, RED MAPLE, H.B. BLUEBERRY, RED CEDAR

Approximate Area of Proposed Site: 5 ACRES (POND AREA ONLY)

Approximate Quantity of Excavation Required (acre-feet): N/A

Construction Access: a). limited b). moderate c). accessible **Description:** DIRT ACCESS ROAD OFF ARTIC [SIC] ROAD

Structures Required/Describe: NONE

Presence of Utilities: NONE VISIBLE ON-SITE. ELECTRIC, GAS, SEWER ADJACENT

Side Slope of Existing Site: 1% TO 5%

Hydrology Input to Existing Site: UNNAMED TRIB (MORE LIKE A DITCH)

Receiving Stream/Water Body: ISOLATED - PROBABLY USED TO BE CONNECTED TO HAVENS COVE OR DRUM POINT

Notes and Sketches: NW CORNER HAS RECENT SURVEY MONUMENT. THERE ARE OTHER SURVEY MARKS ALSO. WETLANDS DELINEATION FLAGS ARE RELATIVELY RECENT. OWNER GOING TO DEVELOP?
- SITE IS SURROUNDED BY DEVELOPMENT - MOST USEFUL RESTORATION WOULD PROBABLY BE AS A LOCAL-LEVEL "NATURAL" PARK.

NWC06

3r

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: W10
GPS Coordinates: RECORDED (W10)
Photo Rolls/Frames: ROLL # 8
Date: 20 DEC. 1999
Crew: STEVE/KATHY

Project Type(s): (circle all that are appropriate)
a) *Phragmites* removal b) fill removal c).tidal re-establishment
d) creation e) structure addition/removal f) other (describe below)

Project/Site Description: POND W/ SAND & GRAVEL MINING OPERATION AT TOP OF HEADWATERS OF FOURMILE BRANCH. REMOVE OLD DIKE & CULVERT & FILL IN POND WITH SAGUE ADJACENT SAND PILES. RE-ESTABLISH FORESTED WETLANDS

Landownership: USFWS (NOT POSTED?) – COULD BE PRIVATE – SAND & GRAVEL CO.

If fill, is it an outstanding violation with the USACE or NJDEP: NOT KNOWN AT PRESENT

Present Land Cover/Uses (on and off-site): – OPEN WATER – SAND & GRAVEL OPER. – PINE/OAK FOREST

Dominant Vegetation: WHITE OAK, PITCH PINE

Approximate Area of Proposed Site: 8 – 10 ACRES

Approximate Quantity of Excavation Required (acre-feet): 5 FT TALL X 125 FEET LONG X 8 FT WIDE

Construction Access: a). limited b). moderate c). accessible **Description:**

Structures Required/Describe: NONE

Presence of Utilities: ELECTRIC LINE ADJACENT

Side Slope of Existing Site: 1% TO 20% (SAND PILES)

Hydrology Input to Existing Site: FOURMILE BRANCH

Receiving Stream/Water Body: MANNAHAWKIN POND/FOURMILE BRANCH

Notes and Sketches:

NWC07

NA
33

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: WB
GPS Coordinates: RECORDED (WB)
Photo Rolls/Frames: ROLL #2

Date: 12/20/99
Crew: SH, KD.

Project Type(s): (circle all that are appropriate)
a) *Phragmites* removal b) fill removal c).tidal re-establishment
d) creation e) structure addition/removal f) other (describe below)

Project/Site Description:
Remove an area of fill from Atlantic White Cedar FOREST

Landownership: PRIVATE

If fill, is it an outstanding violation with the USACE or NJDEP: likely (1970s?)

Present Land Cover/Uses (on and off-site): Mix of Pitchpine forest, opensand, Atlantic White Cedar wetlands

Dominant Vegetation: Pitch Pine, Switchgrass,

Approximate Area of Proposed Site: 10 ACRES

Approximate Quantity of Excavation Required (acre-feet): 30 acre-feet

Construction Access: a). limited b). moderate c). accessible **Description:**

Structures Required/Describe: N/A

Presence of Utilities: Electric line adjacent to Rt 9

Side Slope of Existing Site: 1% – 3%

Hydrology Input to Existing Site: Groundwater

Receiving Stream/Water Body:
UNNAMED TRIB TO SOUTH BR. Forked River

Notes and Sketches:
Adjacent to Industrial AREA
Access Site from Industrial Park Road

NWC08

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: W7
GPS Coordinates: RECORDED (W7)
Photo Rolls/Frames: ROLL #9
Date: 20 DEC. 1999
Crew: STEVE & KATHY

Project Type(s): (circle all that are appropriate)
a) *Phragmites* removal b) fill removal c). tidal re-establishment
d) creation e) structure addition/removal f) other (describe below)

Project/Site Description: LARGE AREA OF FILL ADJACENT TO NICE AWC WETLAND. REMOVE FILL & RE-ESTABLISH AWC WETLANDS.

Landownership: PRIVATE ?

If fill, is it an outstanding violation with the USACE or NJDEP: NOT KNOWN AT PRESENT

Present Land Cover/Uses (on and off-site): - FALLOW FIELD - AWC WETLANDS - RESIDENTIAL

Dominant Vegetation: - SWITCHGRASS/PHRAG MIX - RED MAPLE, PITCH PINE

Approximate Area of Proposed Site: 8-10 ACRES

Approximate Quantity of Excavation Required (acre-feet): 3-5 FEET OVER SITE

Construction Access: a). limited b). moderate c). accessible **Description:**

Structures Required/Describe: NONE

Presence of Utilities: ELECTRIC LINES PRESENT ON DE GUISE ST.

Side Slope of Existing Site: FLAT - 1% TO 3%

Hydrology Input to Existing Site: GROUND H2O

Receiving Stream/Water Body: CEDAR CREEK (THROUGH SEVERAL SMALL UNNAMED TRIBS)

Notes and Sketches: => SITE IS BOUNDED BY DE GUISE, BUNNELL & HAZLETON STREETS (WAS HARD TO FIND!)

NWC09

#47

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: W4 **Date:** 22 December 1999
GPS Coordinates: RECORDED (W4) **Crew:** SPH & KD
Photo Rolls/Frames: ROLL # 12

Project Type(s): (circle all that are appropriate)
a) *Phragmites* removal (b) fill removal c). tidal re-establishment
d) creation e) structure addition/removal f) other (describe below)

Project/Site Description: LARGE AREA OF FILL (≈ 10 YRS OLD) IN AWC FORM

Landownership: PRIVATE

If fill, is it an outstanding violation with the USACE or NJDEP: POTENTIALLY

Present Land Cover/Uses (on and off-site): GRASSLAND / SCATTERED TREES / LIGHT INDUSTRIAL

Dominant Vegetation: SWITCHGRASS / PITCH PINE

Approximate Area of Proposed Site: 10 ACRES

Approximate Quantity of Excavation Required (acre-feet): 50 TO 80 AF

Construction Access: a). limited b). moderate c). accessible **Description:** → SOUTH SYCAMORE RD.

Structures Required/Describe: NONE

Presence of Utilities: ELECTRIC (OTHERS MAY BE PRESENT)

Side Slope of Existing Site: 1% TO 5% ON FILL PILES

Hydrology Input to Existing Site: UPLAND

Receiving Stream/Water Body: UNNAMED TRIBS TO SILVER BAY

AWC WETLANDS

Notes and Sketches:

NWN10

9D

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: W5
GPS Coordinates: RECORDED (W5)
Photo Rolls/Frames: ROLL #12

Date: 22 DECEMBER 1999
Crew: SPH & KD

Project Type(s): (circle all that are appropriate)
a) *Phragmites* removal b) fill removal c).tidal re-establishment
d) creation e) structure addition/removal (f) other (describe below) NONE

Project/Site Description: THIS IS A NON-PROJECT. SITE IS BEHIND OCEAN CO. MALL, AND HAS BEEN DEEPLY EXCAVATED TO CREATE AN HERBACEOUS WETLAND. SITE IS FENCED AND IS POSTED AS "PRIVATE PROPERTY, KEEP OUT."

Landownership: PRIVATE

If fill, is it an outstanding violation with the USACE or NJDEP:

Present Land Cover/Uses (on and off-site):

Dominant Vegetation:

Approximate Area of Proposed Site:

Approximate Quantity of Excavation Required (acre-feet):

Construction Access: a). limited b). moderate c). accessible **Description:**

Structures Required/Describe:

Presence of Utilities:

Side Slope of Existing Site:

Hydrology Input to Existing Site:

Receiving Stream/Water Body:

Notes and Sketches:
LARGE AREA OF FOREST WAS APPARENTLY CLEARED TO CREATE WETLAND. DEEP EXCAVATION WAS REQUIRED TO CREATE WETLAND

NWN11

49

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: W6
GPS Coordinates: RECORDED (W6)
Photo Rolls/Frames: ROLL #12

Date: 22 DECEMBER 1999
Crew: STAKE/KD

Project Type(s): (circle all that are appropriate)
a) *Phragmites* removal b) fill removal c).tidal re-establishment
d) creation e) structure addition/removal f) other (describe below)

Project/Site Description: FAIRLY NICE SITE, OWNED (+ POSTED) BY DOVER TWP. SITE IS AN OLD CRANBERRY BOG, ABANDONED. NOT MUCH TO DO HERE OTHER THAN REMOVE TRASH & SOME OF THE OLD SAND ROADS.

Landownership: DOVER TWP, NJ

If fill, is it an outstanding violation with the USACE or NJDEP: N/A

Present Land Cover/Uses (on and off-site): - AWC FOREST - PP LOWLAND FOREST - HERB WETLANDS - SHRUB/SCRUB

Dominant Vegetation: - AWC - PITCH PINE - H.B. BLUEBERRY - RED MAPLE - WHITE CEDAR - CORNUS AMOMUM - CLETHRA ALNIFOLIA

Approximate Area of Proposed Site: 100 ACRES ?

Approximate Quantity of Excavation Required (acre-feet): 50 ACRE-FEET (?)

Construction Access: a). limited b). moderate c). accessible **Description:**

Structures Required/Describe: NONE

Presence of Utilities: NONE

Side Slope of Existing Site: FLAT TO 5% (ON A FEW MAN-MADE FEATURES)

Hydrology Input to Existing Site: GOOSE CREEK

Receiving Stream/Water Body: BARNEGAT BAY (SILVER BAY?)

Notes and Sketches:
=> STREAM IS TIDAL ON OPPOSITE SIDE OF (SOMER COMPER) ROAD; ON SITE SIDE, TIDE IS CUT OFF. MAY HAVE BEEN THIS WAY FOR MANY YEARS.

=> SITE COULD MAKE A NICE LOCAL-LEVEL PARK W/O MUCH EFFORT.

NWN12

X NON-SITE

#50

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: W11
GPS Coordinates: NOT RECORDED
Photo Rolls/Frames: ROLL #12

Date: 23 DEC. 1999
Crew: SPH & KD

Project Type(s): (circle all that are appropriate)
a) *Phragmites* removal b) fill removal c).tidal re-establishment
d) creation e) structure addition/removal f) other (describe below)

Project/Site Description: NO PROJECT POTENTIAL HERE - PRIVATELY-OWNED SENIOR CENTER DVLPT. MAPPED FEATURE IS A STORM POND.

Landownership: PRIVATE

If fill, is it an outstanding violation with the USACE or NJDEP: NOT CLEAR

Present Land Cover/Uses (on and off-site): HOUSING DVLPT.

Dominant Vegetation: PLANTED CULTIVARS / DIRECTLY OFF SITE IS P.P./WHITE OAK/RED MAPLE

Approximate Area of Proposed Site: ?

Approximate Quantity of Excavation Required (acre-feet): NA

Construction Access: a). limited b). moderate c). accessible **Description:** N/A

Structures Required/Describe: N/A

Presence of Utilities:

Side Slope of Existing Site:

Hydrology Input to Existing Site:

Receiving Stream/Water Body:

Notes and Sketches: A LARGE PART OF THIS DVLPT WAS CONSTRUCTED IN THE LAST 5 YEARS. NO OBVIOUS ADJACENT WETLANDS ANYWHERE (PITCH PINE/OAK/MAPLE FOREST). LOOKS LIKE THEY HAVE DEVELOPED ON TOP OF THE WETLAND!

NWN13

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NON-SITE

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: W2 **Date:** 23 DEC. 1999
GPS Coordinates: NOT RECORDED **Crew:** SPH + KD
Photo Rolls/Frames: NONE

Project Type(s): (circle all that are appropriate) a) *Phragmites* removal b) fill removal c).tidal re-establishment d) creation e) structure addition/removal f) other (describe below)
Project/Site Description: MAP FEATURE MUST BE WRONG. NO WETLANDS HERE - IT IS A RESIDENTIAL NEIGHBORHOOD W/ NO ADJACENT WETLANDS
Landownership: PRIVATE
If fill, is it an outstanding violation with the USACE or NJDEP:
Present Land Cover/Uses (on and off-site): N/A
Dominant Vegetation:
Approximate Area of Proposed Site:
Approximate Quantity of Excavation Required (acre-feet):
Construction Access: a). limited b). moderate c). accessible **Description:**
Structures Required/Describe:
Presence of Utilities:
Side Slope of Existing Site:
Hydrology Input to Existing Site:
Receiving Stream/Water Body:
Notes and Sketches:

2

TWS01

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: 02/OVERWASH **Date:** 29 NOV. 1999
GPS Coordinates: YES **Crew:** HARRIOTT/
Photo Rolls/Frames: ROLL # 1

Project Type(s): (circle all that are appropriate) OVERWASH
a) *Phragmites* removal b) fill removal c).tidal re-establishment
d) creation e) structure addition/removal f) other (describe below)

Project/Site Description: REMOVE DUNE OVERWASH FROM FRONT PART OF TIDAL MARSH. MOST OF AREA IS OUTSIDE OF FENCED AREA FOR DUNE (PROTECTED AREA). ACCESS WOULD BE DIFFICULT.

Landownership: USFWS

If fill, is it an outstanding violation with the USACE or NJDEP: N/A

Present Land Cover/Uses (on and off-site): OVERWASH AREAS PRIMARILY SHRUBBY. SOME HOUSES ADJACENT; BENCH USES

Dominant Vegetation: BAYBERRY, "HEATHER," DOWBERRY, LICHENS (BIG), SAME PHRAG. → SURROUNDED BY S. PATENS, SOME SMALL SALT MARSHES & PANNES

Approximate Area of Proposed Site: SEVERAL SEPARATE WASHOUT AREAS → TOTAL OF 25-30 ACRES

Approximate Quantity of Excavation Required (acre-feet): EACH MOUND IS 10-12 FEET; 300 ACRE-FEET MAX.

Construction Access: a). limited b). moderate c). accessible **Description:**
→ NESTING SEASON FOR PIPING PLOVER & LEAST TERN

Structures Required/Describe: NONE

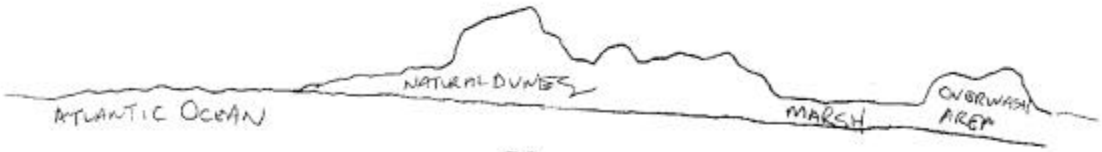
Presence of Utilities: SOME ELECTRIC/WATER/SEWER ON ROADS NEAR HOUSES

Side Slope of Existing Site: FLAT, EXCEPT FOR OVERWASH MOUNDS

Hydrology Input to Existing Site: BAY/ATLANTIC OCEAN

Receiving Stream/Water Body: B. BAY/A. OCEAN

Notes and Sketches:



TWS02

* NEW SITE

4

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: NEW CRANBERRY BOG
GPS Coordinates: RECORDED (NEWCRANB)
Photo Rolls/Frames: MARLENE'S CAMERA

Date: 30 NOV. 1999
Crew: STEVE/MARLENE

Project Type(s): (circle all that are appropriate)
a) *Phragmites* removal b) fill removal c) tidal re-establishment
d) creation e) structure addition/removal f) other (describe below)

Project/Site Description: ABANDONED CRANBERRY BOG ON BALLANGER CREEK. NJDEP INDICATED THIS IS PART OF A NATURAL HERITAGE AREA. RESTORATION OF THE SITE WOULD INVOLVE REMOVAL OF H2O CONTROL STRUCTURE + SMALL DIKE

Landownership: BASS RIVER S.F. (I.E., STATE OF NJ) - NOT POSTED

If fill, is it an outstanding violation with the USACE or NJDEP: UNKNOWN

Present Land Cover/Uses (on and off-site): BOG

Dominant Vegetation: MOSTLY DEAD SNAGS IN BOG. UPLAND PITCH PINE FOREST TO WEST. IMMED. SOUTH OF BOG IS PHRAG W/SOME CATTAILS

Approximate Area of Proposed Site: 80 ACRES ?

Approximate Quantity of Excavation Required (acre-feet): DIKE IS 10-12 FT. WIDE X 8-10 FT. TALL X 200 FT. LONG

Construction Access: a). limited b). moderate c). accessible **Description:**
→ OLD CRANBOG ROAD IN PLACE (SOME WET PLACES)

Structures Required/Describe: NONE

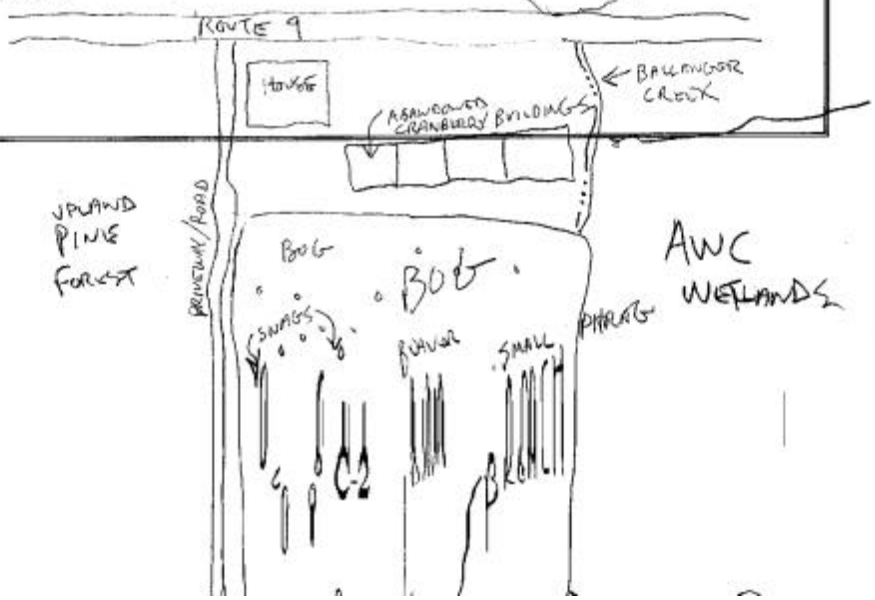
Presence of Utilities: NONE

Side Slope of Existing Site: FLAT (EXCEPT FOR DIKE - SEE ABOVE)

Hydrology Input to Existing Site: BALLANGER CREEK

Receiving Stream/Water Body:
BALLANGER CREEK FLOWS INTO MULLICA RIVER TO THE S.

Notes and Sketches:



TWS03

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: M15/P8 **Date:** 30 Nov. 1999
GPS Coordinates: RECORDED **Crew:** STONE/MARLOWE
Photo Rolls/Frames: ROLL # 1

Project Type(s): (circle all that are appropriate)
a) *Phragmites* removal b) fill removal c) ~~tidal re-establishment~~
d) creation e) structure addition/removal f) other (describe below)

Project/Site Description: DISTURBED TIDAL WETLAND – PART FRESH/PART SALINE.
– REMOVE PHRAG FROM LARGE AREA IN CENTER OF MARSH & MAKE APPROPRIATE HYDROLOGICAL CHANGES (I.E. PART/RE-ROUTE DITCH)

Landownership: USFWS (NOT CERTAIN)

If fill, is it an outstanding violation with the USACE or NJDEP: ~~NOT CERTAIN~~ N/A

Present Land Cover/Uses (on and off-site): TIDAL MARSH, BOUNDED BY PITCH PINE LOWLANDS & WHITE CEDAR FOREST

Dominant Vegetation: PHRAG, SCIRPUS AMER., S. PATENS, S. ALTERNIFLORA, JUNIPERUS VIRG (TYPHA ANG.)

Approximate Area of Proposed Site: 10 ACRES (?)

Approximate Quantity of Excavation Required (acre-feet): N/A

Construction Access: a). limited b). moderate c). accessible **Description:** → EASIEST FROM AIR (AERIAL SPRAYING)

Structures Required/Describe: NO STRUCTURES NEEDED

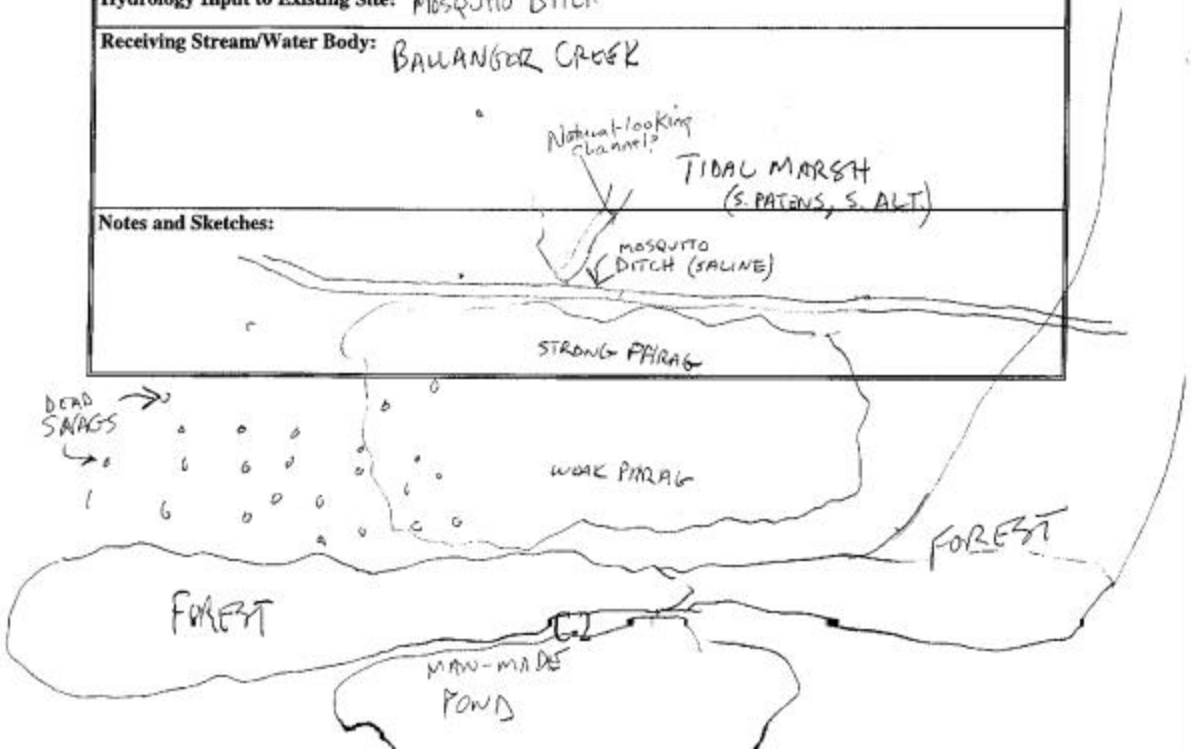
Presence of Utilities: NONE

Side Slope of Existing Site: FLAT

Hydrology Input to Existing Site: MOSQUITO DITCH

Receiving Stream/Water Body: BALANGER CREEK

Notes and Sketches:



TWS04

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: M14 **Date:** 1 DEC. 1999
GPS Coordinates: RECORDED (M14) **Crew:** STEVE & MARLOWE
Photo Rolls/Frames: ROLL #2

Project Type(s): (circle all that are appropriate)
a) *Phragmites* removal b) fill removal c).tidal re-establishment
d) creation e) structure addition/removal f) other (describe below)

Project/Site Description: REMOVE FILL FROM NW CORNER OF TIDAL WETLAND. MAY ALSO BE OPPORTUNITY TO MODIFY EXISTING GRID DITCHES.

Landownership: STATE

If fill, is it an outstanding violation with the USACE or NJDEP: POSSIBLY

Present Land Cover/Uses (on and off-site): TIDAL MARSH & LAGOON RESIDENTIAL COMMUNITY

Dominant Vegetation: SPARTINA PATENS S. ALTERNIFLORA DISTICHLIS SPICATA PHRAGMITES (SMALL AREAS)

Approximate Area of Proposed Site: 3-5 ACRES

Approximate Quantity of Excavation Required (acre-feet): 5 ACRES X 3 FEET = 15 ACRE-FEET

Construction Access: a). limited b). moderate c). accessible **Description:** → PAVED ROAD ADJACENT TO SITE

Structures Required/Describe: N/A

Presence of Utilities: COMMUNITY IS ADJACENT. ELECTRIC, WATER, & SEWER PRESENT ON OTHER SIDE OF ROAD, BUT NOT AT PROJECT SITE.

Side Slope of Existing Site: FLAT

Hydrology Input to Existing Site: UNNAMED DITCHES (SUBSTANTIAL & NUMEROUS)

Receiving Stream/Water Body: LITTLE EGG HARBOR

Notes and Sketches: THIS CORNER OF TIDE MARSH WAS USED FOR DISPOSAL OF CHUNKS OF CONCRETE, ASPHALT, & OTHER MATERIALS. A DIRT/SAND PARKING AREA WAS ALSO EXTENDED INTO MARSH IN NORTHEASTERN-MOST CORNER. SOME MINOR PHRAGMITES REMOVAL MIGHT ALSO BE APPROPRIATE.

TW505

*- NEED TO RE-INVESTIGATE
✓ OK, RE-INVESTIGATED

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: M12
GPS Coordinates: RECORDED (M12)
Photo Rolls/Frames: ROLL # 2
Date: 30 NOV. 1999
Crew: STEVE/MARLENE

Project Type(s): (circle all that are appropriate)
a) *Phragmites* removal b) fill removal c).tidal re-establishment
d) creation e) structure addition/removal f) other (describe below)

Project/Site Description: LARGE AREA OF SAND + GRAVEL FILL, SURROUNDED BY PINES ON 3 SIDES, AND PHRAG ON MARSH SIDE, CONSTRUCTED AS EXTENSION OF ADMIRAL DRIVE (ON MAP AS ADMIRAL DRIVE). MAY HAVE BEEN "STAGING AREA" FOR CONSTRUCTION OF HOUSES.

Landownership: PRIVATE (UNCERTAIN)

If fill, is it an outstanding violation with the USACE or NJDEP: POSSIBLE, ESP. ON EXTENSION ROAD

Present Land Cover/Uses (on and off-site): OPEN SAND, PITCH PINE FOREST, TIDAL MARSH

Dominant Vegetation: PINUS RIGIDA, PHRAG, ROSA PALUSTRIS, PANICUM VIRGATUM

Approximate Area of Proposed Site: 8 ACRES (OPEN SANDY AREA) 2-3 ACRES (ROAD)

Approximate Quantity of Excavation Required (acre-feet): ① 5 ACRES X 8 FEET DEEP
② ROAD: 300 FT LONG X 10 FT WIDE X 4 FT. DEEP

Construction Access: a). limited b). moderate c). accessible **Description:** → EXISTING

Structures Required/Describe: N/A

Presence of Utilities: NONE

Side Slope of Existing Site: FLAT

Hydrology Input to Existing Site: NONE - SITE IS DRY

Receiving Stream/Water Body: "TUNING FORK" MARINA BULPT. DRAINS TO THOMPSONS CREEK (OR HUGHIES CREEK)

Notes and Sketches: MARSH IMMEDIATELY OFFSITE APPEARS TO HAVE NATURALLY OCCURRING DRAINAGE + VEGETATION COMP.

** - WENT BACK + LOOKED AT ROAD THAT EXTENDS WELL INTO MARSH. PHRAG. ON BOTH SIDES, BUT VERY ROBUST TO THE SE. ROAD OBVIOUSLY WAS CONSTRUCTED IN MARSH.

* - PHOTO SEQUENCE FOR M12 CONTINUES AFTER REAL ESTATE PHONE # PHOTO
(NEXT PICTURE IS OF S. GREEN ST. PARK)

*-NEW SITE

TWS06

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: HUGHIES CREEK
GPS Coordinates: Recorded (HUGHIES)
Photo Rolls/Frames: Roll 3
Date: 1 December 1999
Crew: Steve / Marlene

Project Type(s): (circle all that are appropriate)
(a) *Phragmites* removal (b) fill removal c).tidal re-establishment
d) creation e) structure addition/removal f) other (describe below)

Project/Site Description: Sand filled projection into tidal salt marsh. Fill area is approx 800ft long and 20-70ft wide. REMOVE SAND FILL & ADJACENT AREAS OF PHRAGMITES.

Landownership: State

If fill, is it an outstanding violation with the USACE or NJDEP: possibly

Present Land Cover/Uses (on and off-site): site is off Rte 9, behind a gas station; site is crossed by high tension power lines

Dominant Vegetation: Phrag, Spartina patens + S. alterniflora, Limonium (lavender) + Panicum virgatum, Juniperus virginiana

Approximate Area of Proposed Site: 2-5 ACRES

Approximate Quantity of Excavation Required (acre-feet): (3-5 ft deep)

Construction Access: a). limited (b). moderate c). accessible **Description:** Path behind Amoco Station provides easy foot access, but would have to be widened for vehicles. → Boat access may be possible via Hughies Creek.

Structures Required/Describe: N/A

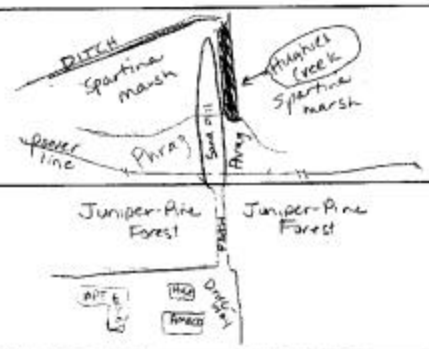
Presence of Utilities: High Tension Power lines perpendicular to linear fill site

Side Slope of Existing Site: Flat

Hydrology Input to Existing Site: (Hughies Creek appears to end next to this site.)

Receiving Stream/Water Body: Hughies Creek

Notes and Sketches:



Rte 9

Note-
Check powerline utility right-of-ways for possible association with Phrag. + possible removal effort.

TW507

17

A Non site (?)

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: P3
GPS Coordinates: N/A
Photo Rolls/Frames: N/A
Date: 1 Dec. 1999
Crew: Steve / Marlene

Project Type(s): (circle all that are appropriate)
a) *Phragmites* removal b) fill removal c).tidal re-establishment
d) creation e) structure addition/removal f) other (describe below)

Project/Site Description: Could not positively locate site. Spent over an hour trying to locate, but had to abandon effort.

Landownership:

If fill, is it an outstanding violation with the USACE or NJDEP:

Present Land Cover/Uses (on and off-site):

Dominant Vegetation:

Approximate Area of Proposed Site:

Approximate Quantity of Excavation Required (acre-feet):

Construction Access: a). limited b). moderate c). accessible **Description:**

Structures Required/Describe:

Presence of Utilities:

Side Slope of Existing Site:

Hydrology Input to Existing Site:

Receiving Stream/Water Body:

Notes and Sketches: ~~Within~~ Maybe Forsythe NWR, but appears to be next to private residences. From Cedar Run Dock Rd into the forest the tree species changed several times:
- Red Maple; Kalmia, Smilax, Sphagnum
- Red Maple, Persimmon, Sweet Gum w/ no understory (most trees were small poles)

TWS08

* - NEED INPUT FROM FWS

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: COLLINS/FWS
GPS Coordinates: RECORDED (COL.FWS)
Photo Rolls/Frames: ROLL #4
Date: 1 DECEMBER 1999
Crew: STEVE/MARLENE

Project Type(s): (circle all that are appropriate)
a) *Phragmites* removal b) fill removal c) tidal re-establishment
d) creation e) structure addition/removal f) other (describe below)

Project/Site Description: RE-ESTABLISH OR MODIFY EXISTING DRAINAGE PATTERNS TO LARGE POND. REMOVE PHRAGMITES AS APPROPRIATE. MODIFY LARGE DITCHES TO IMPROVE ECOLOGICAL FUNCTIONING. → (≤10-15 ACRES TOTAL OF PHRAG)

Landownership: USFWS/FORSYTHE

If fill, is it an outstanding violation with the USACE or NJDEP: N/A

Present Land Cover/Uses (on and off-site): TIDAL MARSH

Dominant Vegetation: SPARTINA PATENS, PHRAGMITES, S. ALTERNIFLORA

Approximate Area of Proposed Site: 50 ACRES (?)

Approximate Quantity of Excavation Required (acre-feet): UNCLEAR - REQUIRES MORE DETAILED STUDY

Construction Access: a). limited b). moderate c). accessible **Description:**
→ DIRT ROAD BACK TO SITE, BUT SITE IS IN SALT MARSH

Structures Required/Describe: NONE

Presence of Utilities: NONE

Side Slope of Existing Site: FLAT

Hydrology Input to Existing Site: MOSQUITO DITCHES & CONNECTORS

Receiving Stream/Water Body:

COLLINS CREEK

Notes and Sketches:

*NOTE LOCKED GATE - END OF DAY, USFWS OFFICE WAS CLOSED.
- ACCESS BY LAND (GET KEY FROM THEM TO AVOID A WALK)

16

TWC09

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: P2 (SEWER LINE ROW) **Date:** December 2, 1999
GPS Coordinates: Recorded (P2) **Crew:** Steve/Marlene
Photo Rolls/Frames: ROLL # 5

Project Type(s): (circle ~~all that are~~ appropriate)
a) *Phragmites* removal b) fill removal c).tidal re-establishment
d) creation e) structure addition/removal f) other (describe below)

Project/Site Description: Feature site appears to be Ocean County Utilities Authority sewer right of way. Dirt road was originally placed through a wetland bordering current Forsythe NWR land (marsh). Site also borders a (fresh) pond.

Landownership: Ocean County Utilities Authority (R.O.W.) Other? USFWS

If fill, is it an outstanding violation with the USACE or NJDEP: Not certain

Present Land Cover/Uses (on and off-site): DIRT ROAD, BORDERED BY OPUNTIA MEADOW, POND, WETLAND FOREST & TIDAL MARSH.

Dominant Vegetation: BROOMSEDGE, SWITCHGRASS, PHRAGMITES, RED MAPLE, RED CEDAR, PITCH PINE, DISTICHLIS SPICATA, SPARTINA PATENS, MISCANTHUS SINENSIS, CAREX STRICTA

Approximate Area of Proposed Site: 5 ACRES

Approximate Quantity of Excavation Required (acre-feet): 5 ACRES X 3 FEET = 15 ACRE-FEET

Construction Access: a). limited b). moderate c). accessible **Description:** THROUGH COUNTY ROW - GET KEY FOR GATE

Structures Required/Describe: N/A

Presence of Utilities: SEWER LINE PRESENT

Side Slope of Existing Site: FLAT

Hydrology Input to Existing Site: DOUBLE CREEK / SMALL TRIBS.

Receiving Stream/Water Body: DOUBLE CREEK

Notes and Sketches: OCUA employee said the sewer line went in in 1978. OCUA maintains a gate (locked) to access the site from Water St.
Local resident spoke of large scale (6 month) marsh modification project (on dikes?) this past year.

=> "PROJECT" MIGHT BE LIMITED TO PHRAG. REMOVAL & MINOR DRAINAGE IMPROVEMENTS, OWING TO PRESENCE OF SEWER LINE.

TWC10

17

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: M7
GPS Coordinates: RecordED (M7)
Photo Rolls/Frames: Roll 4
Date: December 2, 1999
Crew: Steve/Marlene

Project Type(s): (circle all that are appropriate)
a) *Phragmites* removal b) fill removal c).tidal re-establishment
d) creation e) structure addition/removal f) other (describe below)

Project/Site Description: Undeveloped region of dredged + filled lagoonal development Topography is variable resulting in mixed upland + mixed wetland forest as well as fields of Phragmites and Phragmites with mixed grasses and shrubs.

Landownership: Private? [Sign at road entrance refers to a "Preserve".)

If fill, is it an outstanding violation with the USACE or NJDEP: Uncertain

Present Land Cover/Uses (on and off-site): Adjacent to lagoon and lagoonal community. Also adjacent to forest - tidal marsh system near Wire Creek

Dominant Vegetation: Wet meadow: Phrag, Switchgrass, Baccharis, w/ some Distichlis and Spartina sp underneath
Dry Forest: Pine, Maple, Oak Wet Forest: Sweetgum, Red Maple, Grey Birch, Persimmon, Smilax

Approximate Area of Proposed Site: 15-20 acres

Approximate Quantity of Excavation Required (acre-feet): UNCERTAIN, BUT COULD BE 100 ACRE-FEET OR MORE

Construction Access: a). limited (b). moderate c). accessible **Description:** Fill Road needs a little improvement

Structures Required/Describe: NONE

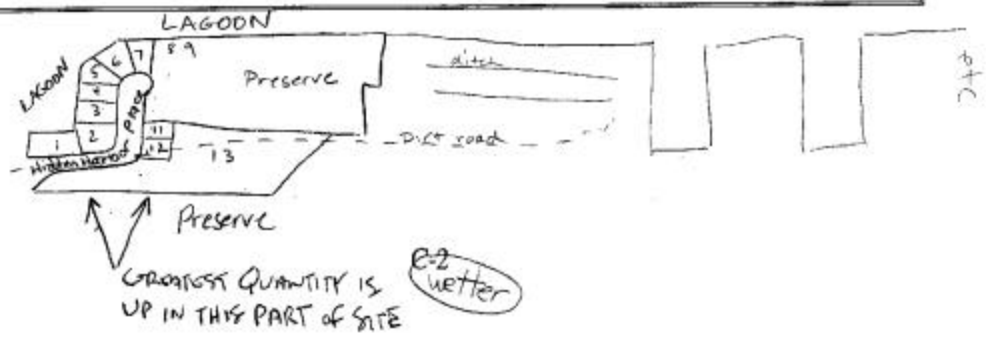
Presence of Utilities: ELECTRIC DISTRIBUTION LINE PRESENT ON SITE

Side Slope of Existing Site: SLOPES AT LAGOON ARE VERTICAL (BULKHEADED). SOME OTHER SLOPES & EDGE ARE 2:1. SLOPES ON SITE ARE VARIABLE, BUT LARGELY FLAT.

Hydrology Input to Existing Site: WIRE CREEK/MOSQUITO DITCHES

Receiving Stream/Water Body: Wire Creek / Lagoon (to Cedar Creek Point) and possibly Hancy's Pond.

Notes and Sketches:
Weichert Realtors 609-693-2800



TWC11

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: M6
GPS Coordinates: RECORDED (MG)
Photo Rolls/Frames: ROLL #3
Date: 3 DECEMBER 1999
Crew: STEVE/MARLENE

Project Type(s): (circle all that are appropriate)
a) *Phragmites* removal b) fill removal c).tidal re-establishment
d) creation e) structure addition/removal f) other (describe below)

Project/Site Description: SMALL PHRAGMITES SITE, ADJACENT TO EXISTING HOUSES AND ROADS. APPEARS CUT OFF FROM TIDE.

Landownership: PRIVATE (UNKCHERT SIGNS)

If fill, is it an outstanding violation with the USACE or NJDEP: NOT KNOWN AT PRESENT

Present Land Cover/Uses (on and off-site): WETLAND MEADOW

Dominant Vegetation: PHRAGMITES/SWITCHGRASS

Approximate Area of Proposed Site: 3 ACRES

Approximate Quantity of Excavation Required (acre-feet): 6-9 ACRE FEET ?

Construction Access: a). limited b). moderate c). accessible **Description:**

Structures Required/Describe: NONE

Presence of Utilities: ELECTRIC DISTRIBUTION LINES PRESENT BORDERING THE SITE

Side Slope of Existing Site: FLAT

Hydrology Input to Existing Site: NONE OBVIOUS -- GROUNDWATER ?

Receiving Stream/Water Body: ISOLATED

Notes and Sketches: SITE IS TOO SMALL & TOO ISOLATED TO DO MUCH WITH.
- VERY DISTURBED AREA.

TWC12

20

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: 01
GPS Coordinates: Recorded (01)
Photo Rolls/Frames: Roll 5

Date: December 3, 1999
Crew: Steve/Marlene

Project Type(s): (circle all that are appropriate)
a) *Phragmites* removal b) fill removal c).tidal re-establishment
d) creation e) structure addition/removal f) other (describe below)

Project/Site Description: Old overwash area on barrier island. Currently consists of shrub thicket, phragmites, rose marsh mallow communities grading into tidal marsh (we assume).

Landownership: State (State Park)

If fill, is it an outstanding violation with the USACE or NJDEP? (Probably not) N/A?

Present Land Cover/Uses (on and off-site): Barrier Island ecosystems (primary + secondary dunes, tidal marsh and wetlands) within state park; roads, trails, bird blind.

Dominant Vegetation: Holly, Red Cedar, Red maple, Pitch Pine, Smilax, Andropogon virginicus, Andropogon glomeratus, PHRAGS, Opuntia, highbush blueberry, Beach Plum, Rose Marsh Mallow

Approximate Area of Proposed Site: 30 acres

Approximate Quantity of Excavation Required (acre-feet): uncertain

Construction Access: (a). limited b). moderate c). accessible **Description:** Area is bordered by foot trail (narrow). A paved 2-lane road runs nearby.

Structures Required/Describe: None

Presence of Utilities: None

Side Slope of Existing Site: (Rolling) 1:5.

Hydrology Input to Existing Site: Surface, rain, ocean mist.

Receiving Stream/Water Body:
Barnegat Bay

Notes and Sketches: Area is part of Island Beach State Park and is bordered by an interpretive trail (with signs by NJ Audubon). The park is heavily visited during the summer.

TWN13

21

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: M2
GPS Coordinates: Recorded (M2)
Photo Rolls/Frames: Roll 5
Date: December 3, 1999
Crew: Steve/Marlene

Project Type(s): (circle all that are appropriate)
a) *Phragmites* removal b) fill removal c) tidal re-establishment
d) creation e) structure addition/removal f) other (describe below)

Project/Site Description: Abandoned homestead with garage, boat + possibly a WELL. Site sits across the street (Beaton Rd) from extensive salt marshes. Site has a large filled area as well as wetlands. Entire site is phrag-covered.

Landownership: Private (for sale)

If fill, is it an outstanding violation with the USACE or NJDEP: Uncertain

Present Land Cover/Uses (on and off-site): Site is bounded by 2 roads (one is major) + two marina-related businesses

Dominant Vegetation: Phragmites, Smilax, Barberry, Juniperus virginiana, Poison Ivy, Switchgrass, Ilex opaca

Approximate Area of Proposed Site: 40 acres ?

Approximate Quantity of Excavation Required (acre-feet): 80 ace feet (Half the site, up to 8 ft)

Construction Access: a). limited b). moderate c). accessible **Description:** Site is bordered by Mantoloking Rd (= Rte 528) and Beaton Rd.

Structures Required/Describe: None (or culverts)

Presence of Utilities: + There may be a well on-site (covered with wood debris) + probably other utilities

Side Slope of Existing Site: 1:4

Hydrology Input to Existing Site: Surface, ground and possibly some connection at the western corner.

Receiving Stream/Water Body: Barnegat Bay / Jones' Tide Pond.

Notes and Sketches:
While the feature site is filled and covered with Phragmites, across Beaton Rd from it, the marsh is a healthy-seeming expanse of Spartina marsh with ponds and grid ditches. Restoration of the feature site would entail phrag removal, fill removal and tidal reestablishment, focusing on hydrologically connecting the two sides of Beaton Rd. Efforts would also require removing a lot of garbage and a garage structure.

Some one recently performed a wetland delineation on-site

TWN14

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: M1 **Date:** December 3, 1999
GPS Coordinates: Record **Crew:** Steve / Marlene
Photo Rolls/Frames: Roll 6

Project Type(s): (circle all that are appropriate)
(a) *Phragmites* removal (b) fill removal c).tidal re-establishment
d) creation e) structure addition/removal f) other (describe below)

Project/Site Description: Dredge disposal site on an island in the Manasquan River. Site is heavily diked around the edges and fill. Fill looks recent and has not reached capacity. Exterior of site is covered in Phrag; interior with Phrag + Baccharis

Landownership: (Not known)

If fill, is it an outstanding violation with the USACE or NJDEP: No, probably not.

Present Land Cover/Uses (on and off-site): Island is fringed with Spartina marsh and crossed by a railroad (NJ Transit) right of way. Remainder of island (around site) is Phrag-covered.

Dominant Vegetation: Phragmites, Baccharis, Black Cherry, Solidago, Switchgrass multiflora rose

Approximate Area of Proposed Site: 200 acres ?

Approximate Quantity of Excavation Required (acre-feet): N/A (Much)

Construction Access: (a). limited b). moderate c). accessible **Description:** Island with deep(?) canal on one side, railroad on another
Boat or rail

Structures Required/Describe: None

Presence of Utilities: None (?)

Side Slope of Existing Site: Nearly vertical.

Hydrology Input to Existing Site: Surface

Receiving Stream/Water Body: Manasquan River

Notes and Sketches:
This site appears to be used currently for disposing of dredged materials. Check historical geology: was site originally bluff-related? Much, much material would need to be removed to create/restore tidal salt marsh. However, if this area were to become tidal salt marsh, it lies in an excellent location for habitat & wildlife (and bird-watching from the mainland) since its only connection to the mainland is via a railroad line.

TWS15

25

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: M9
GPS Coordinates: NOT RECORDED
Photo Rolls/Frames: ROLL #7

Date: 6 DECEMBER 1999
Crew: STEVE/PHIL

Project Type(s): (circle all that are appropriate)
a) *Phragmites* removal b) fill removal c).tidal re-establishment
d) creation e) structure addition/removal f) other (describe below)

Project/Site Description: REMOVE LARGE AREA OF OLD FILL FROM TIDAL MARSH. REMOVE LARGE AREAS OF ADJACENT PHRAGMITES. NOTE THAT SITE M10 (M9A) IS ADJACENT (SIMILAR PROJECT).

Landownership: USFWS (SIGNS POSTED IN AREA)

If fill, is it an outstanding violation with the USACE or NJDEP: NOT KNOWN AT PRESENT

Present Land Cover/Uses (on and off-site): - FILL IN MARSH - OPEN WATER (WESTECUNK CREEK) - TIDAL MARSH - HOUSES, ROAD

Dominant Vegetation: - ON FILL: SPARSE VEG ON FILL ITSELF (PRIMARILY HERBACEOUS); RED CEDARS ON EDGE - TIDAL MARSH: PHRAGMITES (DIRECTLY ADJACENT); S. PATENS, S. ALTERNIFLORA

Approximate Area of Proposed Site: 1800 FEET (ROUGH) X 200 FT (8 ACRES)

Approximate Quantity of Excavation Required (acre-feet): 3 TO 5 FEET OVER ENTIRE AREA

Construction Access: a) limited b) moderate c). accessible **Description:** SEE BELOW

Structures Required/Describe: N/A

Presence of Utilities: NONE

Side Slope of Existing Site: 1% TO 5%

Hydrology Input to Existing Site: NO INPUT ON FILL (PRECIPITATION)

Receiving Stream/Water Body:
WESTECUNK CREEK AND SEVERAL UNNAMED SMALL TIDAL TRIBS.

NICE FW MARSH

Notes and Sketches:

=> NOTE: WESTECUNK CREEK IS ABOUT 6 FEET DEEP AT THIS SITE AT MID-TIDE (UNIFORM)

TWN16

DA 29

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: PRELIMINARY #2 **Date:** 7 DECEMBER 1999
GPS Coordinates: RECORDED (PRELIM 2) **Crew:** STEVE
Photo Rolls/Frames: ROLL # 7

Project Type(s): (circle all that are appropriate)
a) *Phragmites* removal b) fill removal c) tidal re-establishment
d) creation e) structure addition/removal f) other (describe below)

Project/Site Description: SITE CONSISTS OF TWO CONNECTED FORMERLY TIDAL PONDS. PROJECT WOULD CONSIST OF REMOVING EARTHEN IMPOUNDMENTS FROM LOWER PART OF NORTHERN POND AND LOWER PART OF SOUTHERN POND. LARGE AREAS OF PHRAGMITES AROUND LOWER PARTS OF PONDS.

Landownership: PART PRIVATE/PART STATE ?

If fill, is it an outstanding violation with the USACE or NJDEP: NOT KNOWN AT THIS TIME

Present Land Cover/Uses (on and off-site): - OPEN WATER/TIDAL MARSH - UPLAND & WETLAND FOREST - SEWER LINE ROW

Dominant Vegetation: - ATLANTIC WHITE CEDAR - HIGHBUSH BLUEBERRY - PHRAGMITES - PITCH PINE - SPARTINA PATCHES

Approximate Area of Proposed Site: 150 ACRES (?)

Approximate Quantity of Excavation Required (acre-feet): SMALL AMOUNT, TO REMOVE EARTHEN BERMS

Construction Access: a). limited b). moderate c). accessible **Description:** → DIRT ROADS TO PARTS OF SITE - OTHER AREAS DIFFICULT

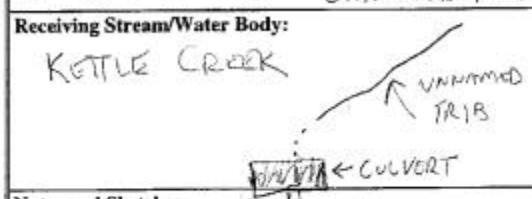
Structures Required/Describe: NONE

Presence of Utilities: SEWER LINE WITHIN ACCESS ROAD

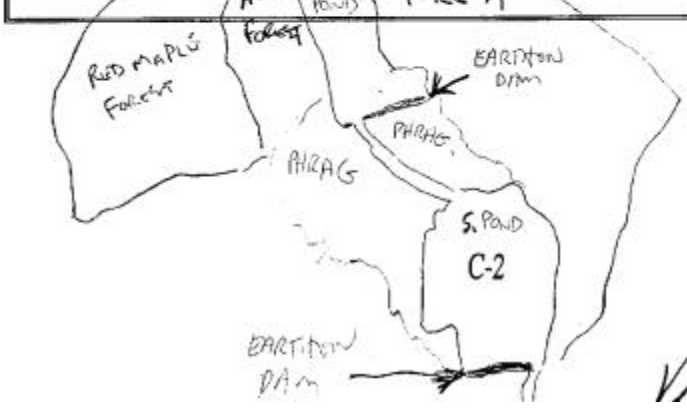
Side Slope of Existing Site: 1% - 3%

Hydrology Input to Existing Site: UNNAMED TRIB. TO KETTLE CREEK

Receiving Stream/Water Body:



Notes and Sketches:



* RE-VISITED SITE BY BOAT - LOWEST PART OF SITE IS A LARGE AREA OF DENSE PHRAG DOWN TO KETTLE CREEK

TWS 17

30

See TWS15
TWS18

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: M10
GPS Coordinates: NOT RECORDED
Photo Rolls/Frames: ROLL # 8

Date: 9 DECEMBER 1999
Crew: STEVE/PHIL/TERRY/JOHN

Project Type(s): (circle all that are appropriate)
a) *Phragmites* removal b) fill removal c) tidal re-establishment
d) creation e) structure addition/removal f) other (describe below)

Project/Site Description: * SEE # M9. REMOVE OR RE-POSITION OLD FILL FROM TIDAL MARSH. REMOVE LARGE AREAS OF PHRAGMITES. MAY BE ABLE TO RE-POSITION SOME OF THE FILL INTO LARGER PILES TO RESTORE THE ORIGINAL MARSH INTERSPERSED WITH OPEN, SANDY PILES (NESTING AREAS?).

Landownership: USFWS (APPARENTLY)

If fill, is it an outstanding violation with the USACE or NJDEP: NOT KNOWN AT PRESENT

Present Land Cover/Uses (on and off-site): - FILL IN MARSH - OPEN WATER (WESTECUNK CREEK) - TIDAL MARSH (FRESH) - HOUSES, ROAD

Dominant Vegetation: - ON FILL: SPARSE, ALL HERBACEOUS; SOME RED CEDARS ON EDGES
- MARSH: PHRAGMITES, THREESQUARE, SWAMP HIBISCUS

Approximate Area of Proposed Site: 900 FEET X 250 FT. (ROUGH EST.)

Approximate Quantity of Excavation Required (acre-feet): 5 TO 8 FEET OVER ENTIRE AREA

Construction Access: a) limited b) moderate c). accessible **Description:** ONLY ACCESSIBLE BY H2O, BUT NOT NECESSARILY A FATAL FLAW

Structures Required/Describe: N/A

Presence of Utilities: NONE

Side Slope of Existing Site: 1% TO 5%

Hydrology Input to Existing Site: NO INPUT ON FILL (PRECIPITATION)

Receiving Stream/Water Body:
WESTECUNK CREEK & SEVERAL UNNAMED SMALL TIDAL TRIBS.

Notes and Sketches:
- DEER PRINTS ALL OVER THESE SITES.
- VERY NICE FW TIDAL MARSH EXISTS IMMEDIATELY TO THE NE OF THE SITE (PAST THE PHRAG IMMEDIATELY SURROUNDING THE SITE), & PROBABLY IN OTHER AREAS, TOO.
- NO SIGNS OF DIAMONDBACK TERRAPINS (AT ANY OF THE 3 SITES)

* - THIS SITE HAS THE DEEPEST FILL OF THE 3 SITES (9, 9A, 10)

TWS 18

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: M9A
GPS Coordinates: NOT RECORDED
Photo Rolls/Frames: ROLL # 8
Date: 9 DECEMBER 1999
Crew: STEVE / PHIL / TURRY / JOHN

Project Type(s): (circle all that are appropriate)
a) *Phragmites* removal b) fill removal c). tidal re-establishment
d) creation e) structure addition/removal f) other (describe below)

Project/Site Description: * SEE #M9. REMOVE OR RE-POSITION OLD FILL FROM TIDAL MARSH. REMOVE LARGE AREAS OF PHRAGMITES; MAY BE ABLE TO RE-POSITION SOME OF THE FILL INTO LARGER PILES, TO RESTORE SOME OF THE ORIGINAL MARSH, INTERSPERSED W/OPEN SANDY PILES (NESTING AREAS?)

Landownership: USFWS (POSTED IN VICINITY)

If fill, is it an outstanding violation with the USACE or NJDEP: NOT KNOWN AT PRESENT

Present Land Cover/Uses (on and off-site): - FILL IN MARSH - TIDAL MARSH (FRESH) - OPEN WATER (WEWEECHUK CREEK) - HOUSES, ROAD

Dominant Vegetation: - ON FILL: SPARSE, PRIMARILY HERBACEOUS; SOME RED CEDARS ON EDGES - MARSH: PHRAGMITES (IMMEDIATE VICINITY)

Approximate Area of Proposed Site: 900 X 125 FEET (ROUGH)

Approximate Quantity of Excavation Required (acre-feet): 3 TO 5 FEET OVER ENTIRE AREA

Construction Access: a). limited b). moderate c). accessible **Description:** → ONLY ACCESSIBLE BY H/D; NOT NEC. A FATAL FLAW

Structures Required/Describe: N/A

Presence of Utilities: NONE

Side Slope of Existing Site: 1% TO 5%

Hydrology Input to Existing Site: NO INPUT ON FILL (PRECIPITATION)

Receiving Stream/Water Body:
WEWEECHUK CREEK & SEVERAL UNNAMED SMALL TIDAL TRIBS.

Notes and Sketches:
- SEE NOTES FOR M9 & M10
- THIS IS THE SMALLEST OF THE 3 RELATED SITES

TWN 19

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: M4
GPS Coordinates: 39°59'.9958/074°09'.0000
Photo Rolls/Frames: Roll #1
Date: 21 DEC. 1999
Crew: STEVE/KATHY/PHIL

Project Type(s): (circle all that are appropriate)
a) *Phragmites* removal b) fill removal c).tidal re-establishment
d) creation e) structure addition/removal f) other (describe below)

Project/Site Description: REMOVE 2 BERMS & BURY SEWER LINE(S?). REMOVE EXTENSIVE AREAS OF PHRAGMITES - RESTORE AWC WETLANDS.

Landownership: STATE ?

If fill, is it an outstanding violation with the USACE or NJDEP: NOT KNOWN

Present Land Cover/Uses (on and off-site): TIDAL MARSH/RESIDENTIAL

Dominant Vegetation: PHRAGMITES

Approximate Area of Proposed Site: 50-80 ACRES ?

Approximate Quantity of Excavation Required (acre-feet): 2 BERMS => 150 FT x 10 FT x 5 FT

Construction Access: a). limited b). moderate c). accessible **Description:**

Structures Required/Describe: REMOVE BERMS & BURY SEWER LINES

Presence of Utilities: SEWER LINE (BUILT ON BERM)

Side Slope of Existing Site: 1% TO 5%

Hydrology Input to Existing Site: UNNAMED TRIB TO SILVER BAY

Receiving Stream/Water Body:
BARNEGAT BAY

Notes and Sketches: NOTE NUMEROUS DEAD AWC SNAGS TO NORTH OF 1ST BERM. HYDROLOGY OF THIS AREA WAS PROB. CHANGED WHEN BERMS WERE CONSTRUCTED. ONE SMALL BREACH IN SW CORNER OF FIRST BERM. COULD NOT GET TO THE MORE NORTHERN BERM W/THE BOAT (TOO SHALLOW).

THE SEWER LINE APPEARS TO BE BURRIED BELOW THE BERM (AT LEAST AT THE BREACH), SO WHY NOT REMOVE IT? COULD AT LEAST INSTALL MORE CULVERTS TO IMPROVE CIRCULATION.

38

TWC20

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: PREUM #8 **Date:** 21 DEC. 1999
GPS Coordinates: 39°50.835 / 074° 08.940 **Crew:** STOVE/PHIL
Photo Rolls/Frames: ROLL #10

Project Type(s): (circle all that are appropriate)
(a) *Phragmites* removal b) fill removal c).tidal re-establishment
d) creation (e) structure addition/removal f) other (describe below)

Project/Site Description: REMOVE VERY LARGE DIKE STRUCTURES FROM TIDAL MARSH. APPEARS TO BE A WMA OF SOME SORT

Landownership: NOT KNOWN @ PRESENT [STATE?]

If fill, is it an outstanding violation with the USACE or NJDEP: NOT KNOWN @ PRESENT

Present Land Cover/Uses (on and off-site): TIDAL MARSH

Dominant Vegetation: S. PATENS, S. ALTERNIFLORA, DESMICHELIA SPICATA

Approximate Area of Proposed Site: 200 ACRES

Approximate Quantity of Excavation Required (acre-feet): 15 FT. WIDE X 5 FT. DEEP X ? LONG DIKES

Construction Access: (a). limited (b). moderate c). accessible **Description:** ACCESS BY DIKES / UPLAND?

Structures Required/Describe: REMOVE TIDE GATE BETWEEN 2 PONDS

Presence of Utilities: NONE

Side Slope of Existing Site: FLAT

Hydrology Input to Existing Site: STOUTS CREEK

Receiving Stream/Water Body:
BARNEGAT BAY

Notes and Sketches:
=> SITE OWNED BY DUCKS UNLIMITED OR OTHER GROUP?
* => WHO BUILT THESE THINGS ?? (NEEDS MORE INFO) THE DIKES DO NOT APPEAR TO BE VERY OLD.

=> LOTS OF OWMMS & MOSQUITO DITCHING IN AREA
=> SITE IS VERY DIFFICULT TO GET TO (AT LEAST FROM BOAT)

TWC21

#31

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: W9 (OYSTER CREEK) **Date:** 21 DEC 1999
GPS Coordinates: 39°48'5294 / 074°10.8200 **Crew:** STEVE/PHIL
Photo Rolls/Frames: ROLL #10

Project Type(s): (circle all that are appropriate)
(a) *Phragmites* removal b) fill removal c).tidal re-establishment
d) creation e) structure addition/removal (f) other (describe below)

Project/Site Description: MAINTAIN LARGE OPEN SANDY AREA (15 ACRES?). REMOVE PHRAG FROM LARGE AREAS OF WETLANDS.

Landownership: NOT KNOWN AT PRESENT (PUBLIC STATE)

If fill, is it an outstanding violation with the USACE or NJDEP: NO, DREDGE DISPOSAL SITE

Present Land Cover/Uses (on and off-site): - OPEN SAND - SMALL UPLAND ISLANDS W/TREES - PHRAG (WET & UP)

Dominant Vegetation: - PHRAG - HIGH BUSH - SWITCHGRASS - BLACK CHERRY

Approximate Area of Proposed Site: 200+ ACRES

Approximate Quantity of Excavation Required (acre-feet): N/A

Construction Access: a). limited b). moderate c). accessible **Description:**

Structures Required/Describe: N/A

Presence of Utilities: NONE

Side Slope of Existing Site: FLAT TO 10% ON DIKES

Hydrology Input to Existing Site: GROUND H2O

Receiving Stream/Water Body: OYSTER CREEK

Notes and Sketches:
** - REVIEW 1998 AERIAL PHOTOS
- TIDE CHART SAYS "BEING ACTIVELY FILLED"
- AREAS USED W/IN PAST 5 YEARS FOR MATERIALS DISPOSAL
- NOTE SEVERAL TERRAPIN SCRAPES & OLD SHELLS OBSERVED ON OPEN SANDY AREA

TWS22

#42

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: CEDAR RUN #1
GPS Coordinates: 39°38.7806/74°15.1435
Photo Rolls/Frames: ROLL #11

Date: 22 DEC. 1999
Crew: PHIL/STEVE

Project Type(s): (circle all that are appropriate)
(a) *Phragmites* removal b) fill removal c). tidal re-establishment
d) creation e) structure addition/removal (f) other (describe below)

Project/Site Description: REDUCE DISPOSAL AREA - DIKED. ONLY PROJECT WOULD BE (CAREFUL) REMOVAL OF PHRAGMITES

Landownership: USFWS

If fill, is it an outstanding violation with the USACE or NJDEP: N/A

Present Land Cover/Uses (on and off-site): - PHRAG MARSH (DIKED)
- TIDAL MARSH

Dominant Vegetation: PHRAGMITES / SPARTINA SPP. - DISTICHLIS

Approximate Area of Proposed Site: 100 ACRES ?

Approximate Quantity of Excavation Required (acre-feet): (MEASURE FROM MAPS)

Construction Access: a). limited b) moderate c). accessible **Description:** >UP CHANNEL CREEK

Structures Required/Describe: NONE

Presence of Utilities: NONE

Side Slope of Existing Site: DIKES ARE 10%, THE REST IS FLAT

Hydrology Input to Existing Site: CHANNEL CREEK

Receiving Stream/Water Body: CEDAR RUN/BARN. BAY

Notes and Sketches:
- HIGH QUALITY TIDAL MARSH HERE - CHANNEL CREEK
- LOOKS NICE

TWS23

See TWS 24
TWS 25

43

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: WEST #1
GPS Coordinates: 39°37.1058/74°16.2087
Photo Rolls/Frames: ROLL #11

Date: 22 DEC. 1999
Crew: STEVE/KATY/PAUL

Project Type(s): (circle all that are appropriate)
(a) *Phragmites* removal b) fill removal c).tidal re-establishment
d) creation e) structure addition/removal f) other (describe below)

Project/Site Description: REMOVE PHRAG FROM DREDGE DISPOSAL SITE + DEPOSIT NEW CLEAN SANDY MATERIALS WHERE APPROPRIATE.

Landownership: USFWS *- ALL THREE SITES ARE PRIMARILY UPLAND (I.E. NON-WETLAND)

If fill, is it an outstanding violation with the USACE or NJDEP: NO

Present Land Cover/Uses (on and off-site): PHRAG MARSH/OPEN H2O (CREEK)

Dominant Vegetation: PHRAGMITES

Approximate Area of Proposed Site: 30 ACRES ?

Approximate Quantity of Excavation Required (acre-feet): NOT CLEAR

Construction Access: a). limited b). moderate c). accessible **Description:**
BOAT ONLY

Structures Required/Describe: NONE

Presence of Utilities: NONE

Side Slope of Existing Site: FLAT TO 5%

Hydrology Input to Existing Site: WESTECUNK CREEK

Receiving Stream/Water Body: BARNEGAT BAY

Notes and Sketches:
* => NOTE DIKES NOT PRESENT @ ANY OF THE 3 WEST SITES
- THEY APPEAR FAIRLY OLD DISPOSAL SITES

=> NICE AREAS OF FW MARSH ADJACENT

TWS24

44

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: WEST #2 **Date:** 22 DEC. 1999
GPS Coordinates: 39°37.2780N 74°16.3455 **Crew:**
Photo Rolls/Frames: ROLL #11

Project Type(s): (circle all that are appropriate)
a) *Phragmites* removal b) fill removal c).tidal re-establishment
d) creation e) structure addition/removal f) other (describe below)

Project/Site Description: SEE DESCRIPTION FOR WEST #1

Landownership: USFWS

If fill, is it an outstanding violation with the USACE or NJDEP:

Present Land Cover/Uses (on and off-site):

Dominant Vegetation:

Approximate Area of Proposed Site: 3.0 ACRES (?)

Approximate Quantity of Excavation Required (acre-feet):

Construction Access: a). limited b). moderate c). accessible **Description:**
BY WATER ONLY

Structures Required/Describe: NONE

Presence of Utilities: NONE

Side Slope of Existing Site:

Hydrology Input to Existing Site:

Receiving Stream/Water Body:

Notes and Sketches:

TW525

#45

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: West #3
GPS Coordinates: 39°37.4159'/74°12'.8169
Photo Rolls/Frames: Roll #11

Date: 22 Dec. 1999
Crew: Steve/Phil/KD

Project Type(s): (circle all that are appropriate)	a) *Phragmites* removal b) fill removal c).tidal re-establishment d) creation e) structure addition/removal f) other (describe below)
Project/Site Description:	See Data sheet West #1
Landownership:	USFWS
If fill, is it an outstanding violation with the USACE or NJDEP:	NO
Present Land Cover/Uses (on and off-site):	Phragmites marsh
Dominant Vegetation:	Phragmites
Approximate Area of Proposed Site:	20-30 acres
Approximate Quantity of Excavation Required (acre-feet):	Not clear
Construction Access:	a). limited b). moderate c). accessible by water only **Description:**
Structures Required/Describe:	None
Presence of Utilities:	None
Side Slope of Existing Site:	Flat to 3%
Hydrology Input to Existing Site:	Westecunk Creek
Receiving Stream/Water Body:	Westecunk Creek/Barnegat Bay
Notes and Sketches:	This is the lowest (i.e. wettest) of the 3 West sites - it still appears to be primarily upland.

TWC26

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: MAIN POINT/POINT LOOKOUT **Date:** 22 Dec
GPS Coordinates: 39° 40.8590/74° 11.3666 **Crew:** STEVE/PHIL/KD
Photo Rolls/Frames: ROLL #11 (END)

Project Type(s): (circle all that are appropriate)
(a) *Phragmites* removal b) fill removal c).tidal re-establishment
d) creation e) structure addition/removal f) other (describe below)

Project/Site Description: OLD DREDGE DISP. SITE, COVERS MOST OF POINT (VERY LARGE).
- PHRAG REMOVAL/TREE PLANTING

Landownership: USFWS

If fill, is it an outstanding violation with the USACE or NJDEP: NOT KNOWN

Present Land Cover/Uses (on and off-site): DREDGE DISP. SITE (APPROX 26 OLD - NO DIKES) a EROSION/SLUMPING ON SOME SIDES)

Dominant Vegetation: PHRAGMITES

Approximate Area of Proposed Site: 200 ACRES (?)

Approximate Quantity of Excavation Required (acre-feet): N/A

Construction Access: a). limited b). moderate c). accessible **Description:** ↳ CONNECTED TO LAND

Structures Required/Describe: N/A (PROB. NOT)

Presence of Utilities: N/A (PROB. NOT)

Side Slope of Existing Site: 1% TO 3%

Hydrology Input to Existing Site: RAIN/PRECIP.

Receiving Stream/Water Body: BARNEGAT BAY

Notes and Sketches:
=> NEED TO LOOK @ RECENT AERIALS TO ESTABLISH SITE BOUNDARIES (VERY LARGE)
=> PHRAGMITES AS FAR AS THE EYE CAN SEE!

TWN27

#52

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: PRELIM #3
GPS Coordinates: RECORDED (PRELIM #3)
Photo Rolls/Frames: ROLL #12

Date: 23 DEC. 1999
Crew: SPH & KD

Project Type(s): (circle all that are appropriate)
(a) *Phragmites* removal b) fill removal c) tidal re-establishment
d) creation e) structure addition/removal f) other (describe below)

Project/Site Description: AREA OF SALT MARSH W/ PHRAG & RED CEDARS. EXISTING VERY SHALLOW POND (DOESN'T LOOK NATURAL) WITH ALMOST NO TIDAL FLUSHING. REMOVE PHRAG FROM 5 TO 8 ACRES & IMPROVE TIDAL FLUSHING TO POND.

Landownership: USFWS

If fill, is it an outstanding violation with the USACE or NJDEP: N/A

Present Land Cover/Uses (on and off-site): - TIDAL MARSH - PHRAG/RED CEDAR - UPLAND FOREST

Dominant Vegetation: - PHRAG/RED CEDAR - S. PATENS/DISTICHLIS

Approximate Area of Proposed Site: 20 ACRES (MAY BE LARGER)

Approximate Quantity of Excavation Required (acre-feet): NONE

Construction Access: a). limited b). moderate c). accessible **Description:** MANDALAY ROAD

Structures Required/Describe: NONE

Presence of Utilities: ELECTRIC LINE ALONG MANDALAY ROAD

Side Slope of Existing Site: FLAT TO 1%

Hydrology Input to Existing Site: MOSQUITO DITCHES (MAY BE OLD)

Receiving Stream/Water Body: KETTLE CREEK

Notes and Sketches:
* => COULD BE A GOOD PROSPECT FOR SOME SHORT TRAILS & WILDLIFE VIEWING PLATFORMS. NOT MUCH OF A PROJECT!

TWH28

53

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: PRELIM #4 **Date:** 23 Dec 1999
GPS Coordinates: RECORDED (PRELIM #4) **Crew:** SAT & KD
Photo Rolls/Frames: ROLL 12 & 13

Project Type(s): (circle all that are appropriate)
(a) *Phragmites* removal b) fill removal (c) tidal re-establishment
d) creation e) structure addition/removal (f) other (describe below)

Project/Site Description: REMOVE PHRAG FROM LARGE SITE ADJACENT TO SEWER ROW. NEED TO IMPROVE CIRCULATION – THE ROW HAS PONDED AREAS ON BOTH E & W OF ROW AND THE AWC WETLANDS COULD BE RE-ESTABLISHED IF AREA WAS PROPERLY DRAINED & PHRAG WAS REMOVED.

Landownership: STATE w/ COUNTY ROW FOR SEWER?

If fill, is it an outstanding violation with the USACE or NJDEP: NOT KNOWN @ PRESENT

Present Land Cover/Uses (on and off-site): – PHRAG MARSH – VPLAND/WETLAND FOREST – RESIDENTIAL

Dominant Vegetation: – PHRAG – RED MAPLE/SWEETGUM – AWC

Approximate Area of Proposed Site: – ENTIRE SITE IS ≈125 ACRES – PHRAG IS ≈ 50 ACRES

Approximate Quantity of Excavation Required (acre-feet): NONE

Construction Access: a). limited b). moderate c). accessible **Description:** FROM SEWER ROW

Structures Required/Describe: NONE. MAY BE WATER CONTROL STRUCTURES IN EASTERN-MOST PART

Presence of Utilities: SEWER LINE

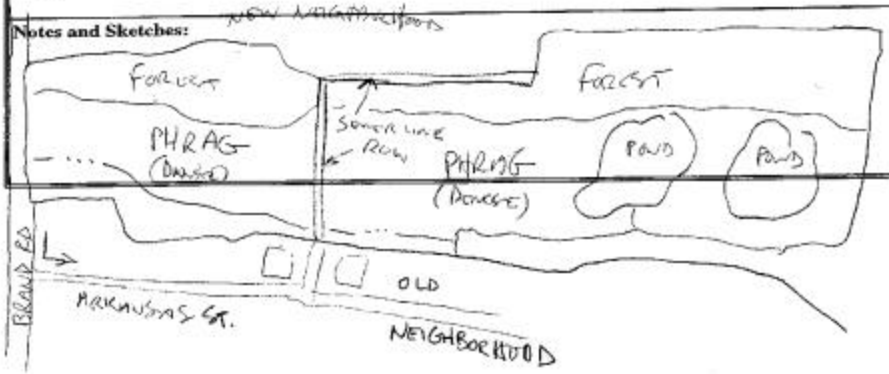
Side Slope of Existing Site: 1% TO 5% (SLOPE ON ROW)

Hydrology Input to Existing Site: UNNAMED TRIB TO KETTLE CK.

Receiving Stream/Water Body: KETTLE CREEK

*– CHECK TO SEE IF KETTLE CREEK IS TIDAL TO HERE

Notes and Sketches:



TWN29

54

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: PRELIM #6 (CITTUS) **Date:** 23 DEC. 1999
GPS Coordinates: RECORDED (PRELIM #6) **Crew:** SH & KD
Photo Rolls/Frames: ROLL #13

Project Type(s): (circle all that are appropriate) DIKE
(a) *Phragmites* removal (b) fill removal (c) tidal re-establishment
d) creation e) structure addition/removal f) other (describe below)

Project/Site Description: REMOVE/BREACH OLD CRANBERRY DIKE FROM SE AREA OF PARK. DIKE CURRENTLY DIVIDES TIDAL MARSH ALONG BARNEGAT BAY FROM FORMER CRANBERRY BOG. MUCH OF LAND WITHIN SIDE OF DIKE HAS PHRAG COVER. SEVERAL SMALL DIKE BREACHES EXIST - BIGGER ONES NEARBY

Landownership: OCEAN CO.

If fill, is it an outstanding violation with the USACE or NJDEP: N/A

Present Land Cover/Uses (on and off-site): - WETLAND FOREST - PHRAG MARSH - TIDAL MARSH

Dominant Vegetation: PHRAG & PATCHES DISTICHLIS RED MAPLE, BLACK GUM, SWEET GUM

Approximate Area of Proposed Site: 20-30 ACRES (PHRAG ONLY) (VARIABLE; DEPENDS ON OPTIONS)

Approximate Quantity of Excavation Required (acre-feet): ~ 1,500 FT X 8FT. X 5FT. ← TO REMOVE ALL OF DIKE

Construction Access: a). limited b). moderate c). accessible **Description:** → MAY HAVE TO ACCESS THROUGH MARSH - CHECK

Structures Required/Describe: NONE

Presence of Utilities: NONE

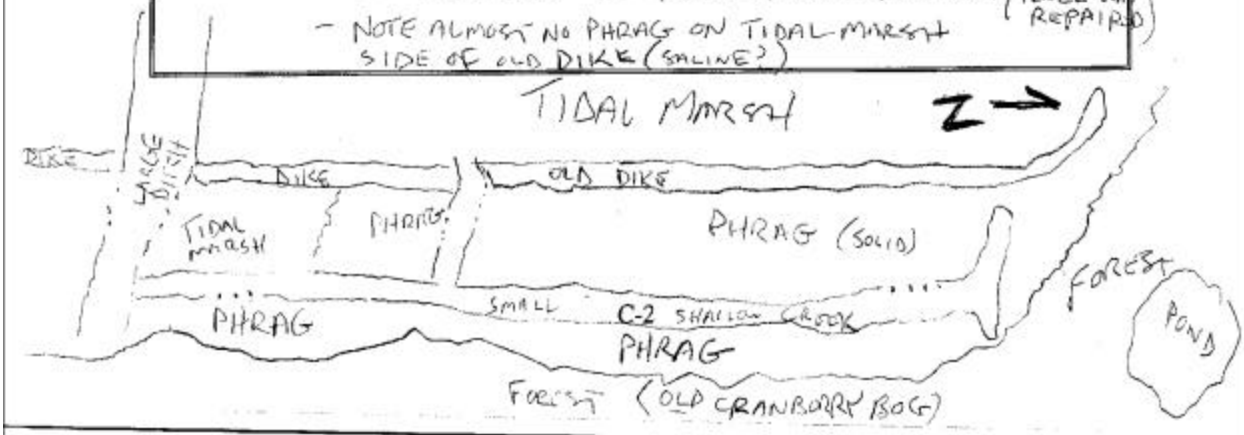
Side Slope of Existing Site: FLAT TO 5% (ON DIKE)

Hydrology Input to Existing Site: UNNAMED CREEK/DITCHES CONNECTED TO BAY

Receiving Stream/Water Body: BARNEGAT BAY

Notes and Sketches:
- ACCESS SITE THROUGH TENNIS COURT/BALLFIELD AREA.
- COULD NOT GET TO POND - ACCESS DIFFICULT (FENCE WAS REPAIRED)
- NOTE ALMOST NO PHRAG ON TIDAL MARSH SIDE OF OLD DIKE (SALINE?)

TENNIS COURT



TW530

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: SITE # 502
GPS Coordinates: RECORDED (502)
Photo Rolls/Frames: ROLL # 101

Date: 17 FEBRUARY 2000
Crew: SPK & KD

Project Type:	(a). *Phragmites* removal b). fill removal c). tidal re-establishment d). creation e). structure addition/removal (f). other (describe below)
Project/Site Description:	REMOVE PHRAGS FROM SMALL REACHES OF CHANNEL TO BIG THOROFARE (BOTH SIDES). PHRAG. MAY BE KEPT IN CHECK FROM SALINITY OF WATER. NOT MUCH OPPORTUNITY HERE...
Present Land Cover/Uses (on and off-site):	TIDAL MARSH
Approximate Area of Proposed Site:	25 ACRES (?)
Approximate Quantity of Excavation Required (acre-feet):	N/A
Construction Access:	a). limited b). moderate c). accessible **Description:**
Structures Required/Describe:	N/A
Presence of Utilities:	ELECTRIC DIST. LINE ADJACENT TO GB. BLVD. BRIDGE
Side Slope of Existing Site:	FLAT
Hydrology Input to Existing Site:	CHANNEL TO BIG THOROFARE
Receiving Stream/Water Body:	BARNEGAT BAY
Notes and Sketches:	OBSERVED SITE CHANNEL FROM THE GB. BLVD BRIDGE. NO OTHER TERRESTRIAL ACCESS THROUGH GOLF COURSE NEIGHBORHOOD (DON'T GO THERE!).

TWS31

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: SITE # 114
GPS Coordinates: RECORDED
Photo Rolls/Frames: ROLL # 101

Date: 17 FEB 2000
Crew: SPM & KD

Project Type:	a). *Phragmites* removal b). fill removal c). tidal re-establishment d). creation e). structure addition/removal (f). other (describe below)
Project/Site Description:	DREDGE THOMPSONS CREEK TO IMPROVE NAVIGATION AND TIDAL FLUSHING IN AREA OF LAGOONS OFF ADMIRAL DRIVE. VERY LITTLE PHRAG PRESENT HERE.
Present Land Cover/Uses (on and off-site):	TIDAL MARSH/RESIDENTIAL
Approximate Area of Proposed Site:	UNCERTAIN
Approximate Quantity of Excavation Required (acre-feet):	UNCERTAIN
Construction Access:	a). limited b). moderate c). accessible → BOAT ONLY **Description:**
Structures Required/Describe:	NONE
Presence of Utilities:	NONE
Side Slope of Existing Site:	FLAT
Hydrology Input to Existing Site:	THOMPSONS CREEK
Receiving Stream/Water Body:	BARNEGAT BAY
Notes and Sketches:	CREEK DOES LOOK RELATIVELY SHALLOW, BUT NOT MUCH WRONG ECOLOGICALLY.

TWC32

57

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: SATELLITE
GPS Coordinates: RECORDED
Photo Rolls/Frames: ROLL # 101

Date: 17 FEB 2000
Crew: SCHd KD

Project Type:	a). *Phragmites* removal b). fill removal c). tidal re-establishment d). creation e). structure addition/removal (f) other (describe below)
Project/Site Description:	DECREASE FRAGMITES FORKED RIVER. WE DON'T SEE ANY OBVIOUS ECOLOGICAL REASON FOR SUCH A PROJECT. WOULD REQUIRE SOME MORE STUDY
Present Land Cover/Uses (on and off-site):	OPEN RIVER/TIDAL MARSH
Approximate Area of Proposed Site:	UNDETERMINED
Approximate Quantity of Excavation Required (acre-feet):	UNDETERMINED
Construction Access:	a). limited b). (moderate) c). accessible **Description:** BOAT ONLY
Structures Required/Describe:	N/A
Presence of Utilities:	ELECTRIC LINES PRESENT
Side Slope of Existing Site:	FLAT
Hydrology Input to Existing Site:	FORKED RIVER
Receiving Stream/Water Body:	BARNEGAT BAY
Notes and Sketches:	PROJECT DOESN'T APPEAR VERY WELL-JUSTIFIED IN ECOLOGICAL TERMS.

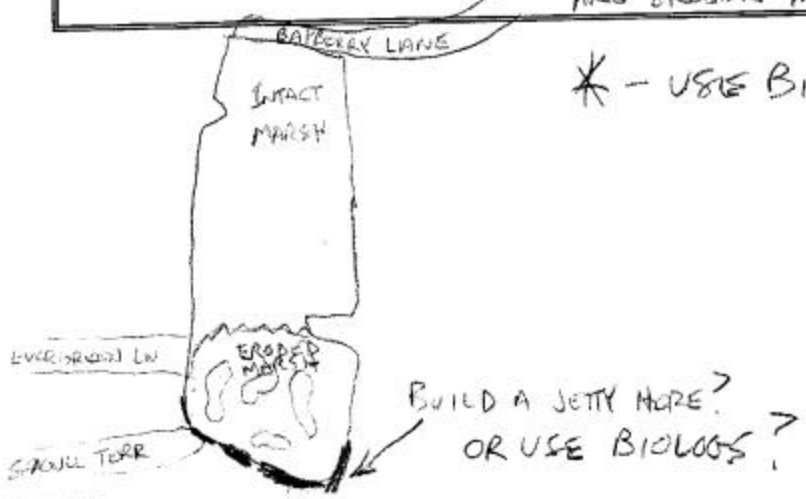
TWN33

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: SITE # 202
GPS Coordinates: RECORDED (202)
Photo Rolls/Frames: ROLL # 101

Date: 18 FEB 2000
Crew: SPH & KD

Project Type:	a). *Phragmites* removal b). fill removal c). tidal re-establishment d). creation e). structure addition/removal (f) other (describe below)
Project/Site Description:	AREA OF ERODED MARSH ON BEAVER CREEK. LOWEST PART OF MARSH IS MOST ERODED. COULD BE A RE-VEG. PROJECT. IDEA WOULD BE TO RE-ESTABLISH VEGETATION IN THE LOWEST PART OF MARSH.
Present Land Cover/Uses (on and off-site):	TIDAL MARSH
Approximate Area of Proposed Site:	20-25 ACRES
Approximate Quantity of Excavation Required (acre-feet):	NONE
Construction Access: a). limited b). moderate c). accessible	**Description:** WATER ONLY (BEAVER DAM CREEK)
Structures Required/Describe:	PROBABLY NONE
Presence of Utilities:	NONE ON SITE
Side Slope of Existing Site:	FLAT
Hydrology Input to Existing Site:	BEAVER DAM CREEK
Receiving Stream/Water Body:	METEDECONK RIVER
Notes and Sketches:	RE-VEGETATE FROM PLANTS COLLECTED IN VAPOR (INTACT) MARSH? IT MAY BE IMPOSSIBLE TO ESTABLISH VEG WITHOUT SOME STRUCTURAL FIX. CURRENT FROM RIVER & WAKES PROBABLY ARE ERODING MARSH.



* - USE BIOLOGS?

BUILD A JETTY HERE? OR USE BIOLOGS?

TWN34

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: SITE #109
GPS Coordinates: RECORDED (#109)
Photo Rolls/Frames: ROLL #101

Date: 18 FEB. 2000
Crew: SPIT + KD

Project Type:	(a) *Phragmites* removal b). fill removal c). tidal re-establishment d). creation e). structure addition/removal f). other (describe below)
Project/Site Description:	NARROW ISLANDS, COVERED WITH PHRAG & SCATTERED TREES (QUERCUS ALBA, PINUS RIGIDA). ISLANDS ARE VERY NARROW AND ARE PROBABLY RELATIVELY ECOLOGICALLY INSIGNIFICANT - TOO CLOSE TO HEAVILY POPULATED AREA. LOTS OF BOATS TOO
Present Land Cover/Uses (on and off-site):	ISLANDS
Approximate Area of Proposed Site:	2-3 ACRES
Approximate Quantity of Excavation Required (acre-feet):	NONE
Construction Access:	a). limited b). moderate c). accessible — WATER ONLY — **Description:**
Structures Required/Describe:	NONE
Presence of Utilities:	NONE APPARENT
Side Slope of Existing Site:	FLAT TO 3%
Hydrology Input to Existing Site:	BEAVER DAM CREEK/METEDECONK RIVER
Receiving Stream/Water Body:	METEDECONK RIVER
Notes and Sketches:	NOTE MAKE SURE OFFSET OF 320° AND 100 METERS IS APPROPRIATE (FROM BANCROFT RD.) - THERE ARE QUITE A FEW OF THESE ISLANDS; MOST ARE IMPOSSIBLE TO SEE FROM LAND.

62

~~TWN34~~
TWN35

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: SITE #201
GPS Coordinates: RECORDED (211)
Photo Rolls/Frames: ROLL #102

Date: 18 FEB. 2000
Crew: SDK & KD

Project Type:	a). *Phragmites* removal b). fill removal c). tidal re-establishment d). creation e). structure addition/removal (f). other (describe below)
Project/Site Description:	DREDGE SOUTHERN BRANCH OF KETTLE CREEK TO IMPROVE NAVIGATION.
Present Land Cover/Uses (on and off-site):	OPEN WATER/RESIDENTIAL
Approximate Area of Proposed Site:	N/A
Approximate Quantity of Excavation Required (acre-feet):	NONE
Construction Access: a). limited b). moderate c). accessible	**Description:** WATER ONLY
Structures Required/Describe:	N/A
Presence of Utilities:	NONE (OPEN WATER)
Side Slope of Existing Site:	FLAT
Hydrology Input to Existing Site:	KETTLE CREEK
Receiving Stream/Water Body:	BARNEGAT BAY
Notes and Sketches:	NOT MUCH OPPORTUNITY HERE. WE SEE LITTLE REASON ECOLOGICALLY TO PERFORM SUCH A PROJECT.

63

~~TWN34~~
TWN36

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: SITE #113
GPS Coordinates: RECORDED (113)
Photo Rolls/Frames: ROLL #102

Date: 18 FEB. 2000
Crew: SPR & KD

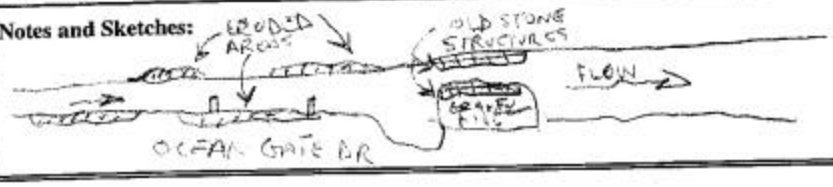
Project Type:	a). *Phragmites* removal (b). fill removal c). tidal re-establishment d). creation (e). structure addition/removal f). other (describe below)
Project/Site Description:	REMOVE OLD PILINGS, PARKING LOT, AND FILL FROM ABANDONED MARINA. SEE NOTES BELOW.
Present Land Cover/Uses (on and off-site):	ABANDONED LOT
Approximate Area of Proposed Site:	10 ACRES ?
Approximate Quantity of Excavation Required (acre-feet):	20-30 ACRE FEET
Construction Access: a). limited b). moderate c). accessible	**Description:**
Structures Required/Describe:	NONE
Presence of Utilities:	ELECTRIC DISTRIBUTION LINE (MAY BE OTHERS)
Side Slope of Existing Site:	FLAT; BULKHEADED @
Hydrology Input to Existing Site:	TOMS RIVER
Receiving Stream/Water Body:	BARNEGAT BAY
Notes and Sketches:	WOULD BE A LARGE AMOUNT OF FILL TO REMOVE FOR A SMALL MARSH RESTORATION. WOULD THERE BE MUCH ECOLOGICAL BENEFIT TO REMOVING JUST THE OLD DOCKS & PILINGS ?

~~TWC39~~
TWC37

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: SITE # 302
GPS Coordinates: RECORDED (302)
Photo Rolls/Frames: ROLL #102

Date: 18 FEBRUARY 2000
Crew: SPH & KD

Project Type:	a). *Phragmites* removal b). fill removal c). tidal re-establishment d). creation (e). structure addition/removal (f). other (describe below)
Project/Site Description:	REMOVE OLD STONE BRIDGE STRUCTURE & STABILIZE BANKS ON JEFFRIES CREEK. OLD STRUCTURE IMPEDES STREAM FLOW
Present Land Cover/Uses (on and off-site):	WATERWAY
Approximate Area of Proposed Site:	800-1000 FT OF STREAM (BOTH BANKS)
Approximate Quantity of Excavation Required (acre-feet):	NONE
Construction Access: a). limited b). moderate (c). accessible	**Description:**
Structures Required/Describe:	NONE
Presence of Utilities:	ELECTRIC DISTRIBUTION LINE (MAY BE OTHERS)
Side Slope of Existing Site:	3% TO 8%
Hydrology Input to Existing Site:	JEFFRIES CREEK
Receiving Stream/Water Body:	TOMS RIVER
Notes and Sketches:	

TWC 38

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: Site # 105 (N. Inlet)
GPS Coordinates: Recorded
Photo Rolls/Frames: # 236

Date: 29 February 2000
Crew: SPH, FSK, JB

Project Type:	a). *Phragmites* removal b). fill removal c). tidal re-establishment d). creation e). structure addition/removal f). other (describe below)
Project/Site Description:	BUILD LARGE OPEN SANDY AREA WITH MATERIALS FROM DREDGING OF MAIN CHANNEL. COULD GET ABOUT 25-30 ACRES IN EASILY
Present Land Cover/Uses (on and off-site):	DUNES, OPEN WATER
Approximate Area of Proposed Site:	25 ACRES (?)
Approximate Quantity of Excavation Required (acre-feet):	H2O IS ABOUT 3-5 FT. AT HIGH TIDE
Construction Access: a). limited b). moderate c). accessible	**Description:** ROADS PRIMARILY (SOME ACCESS OVER MUD)
Structures Required/Describe:	GEOTUBES? ROCKS?
Presence of Utilities:	NONE
Side Slope of Existing Site:	SOME OF DUNES ARE NEARLY 1:1 TO 2:1
Hydrology Input to Existing Site:	BARN INLET
Receiving Stream/Water Body:	SAME
Notes and Sketches:	WOULD BE A VERY EXPENSIVE PROJECT, BUT MAY BE WORTHWHILE OWING TO ISOLATION OF SITE.

TWS39

Barnegat Bay Watershed Analysis
Wetland Site Data

Location ID/Name: SITE #106
GPS Coordinates: RECORDED (106)
Photo Rolls/Frames: #100

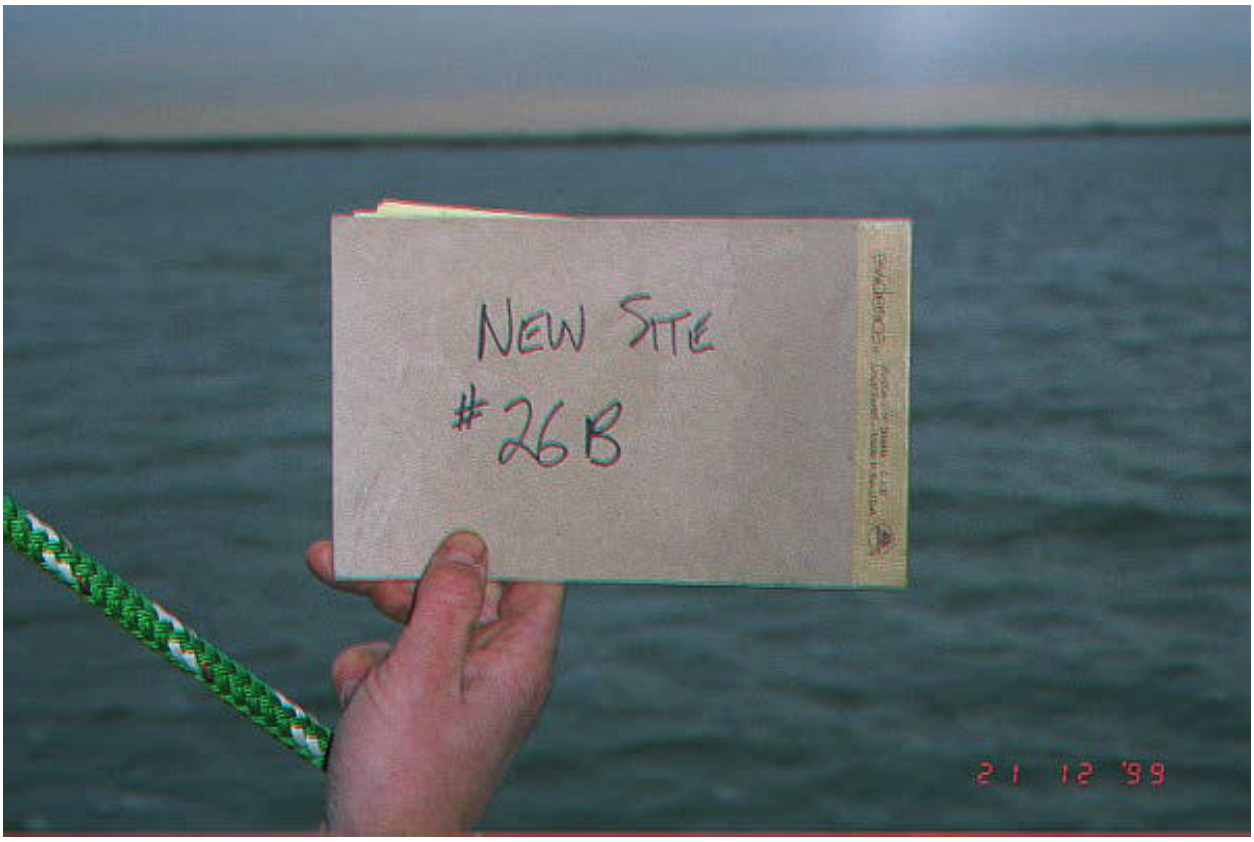
Date: 17 FEBRUARY 2000
Crew: SPH & KD

Project Type:	a). *Phragmites* removal b). fill removal c). tidal re-establishment d). creation e). structure addition/removal f). other (describe below)
Project/Site Description:	REMOVE PHRAGMITES, AMOPHILA, & OTHER VEG FROM AREA TO SOUTH OF SOUTH JETTY. AREA OF CONCERN IS ABOUT 30 ACRES (?) HERBICIDE PHRAG & COVE AREA W/ SANDY DREDGED MATERIALS.
Present Land Cover/Uses (on and off-site):	LONG BEACH S.P.
Approximate Area of Proposed Site:	≈ 30 ACRES (?)
Approximate Quantity of Excavation Required (acre-feet):	N/A
Construction Access:	a). limited b). moderate c). accessible **Description:**
Structures Required/Describe:	NONE (SNOW-TYPE FENCING)
Presence of Utilities:	NONE OBSERVED
Side Slope of Existing Site:	SITE ITSELF IS FLAT. IMMEDIATELY TO S IS ROLLING DUNES.
Hydrology Input to Existing Site:	ATLANTIC OCEAN (MAY BE ONE LARGE WET SPOT BACK IN PHRAG)
Receiving Stream/Water Body:	NONE
Notes and Sketches:	SKETCH BOUNDARIES OF SITE FROM MOST RECENT AERIALS (PHRAG. DOESN'T SHOW ON 1995 PHOTO). WOULD BE HELPFUL TO SEE FROM LIGHTHOUSE.

APPENDIX C

PHOTOGRAPHS FROM FIELD INVESTIGATION

(Included on Accompanying CD)


NEW SITE
#26B
21 12 '99

21 12 '99

21 12 '99

21 12 '99

21 12 '99

21 12 '99

21 12 '99

20 2 '00

28 2 '00

28 2 '00

2 8 2 '00

28 2 '00

STOCKING
POINT
21 12 99

24 12 '99

HERRING
ISLAND

21 12 '99

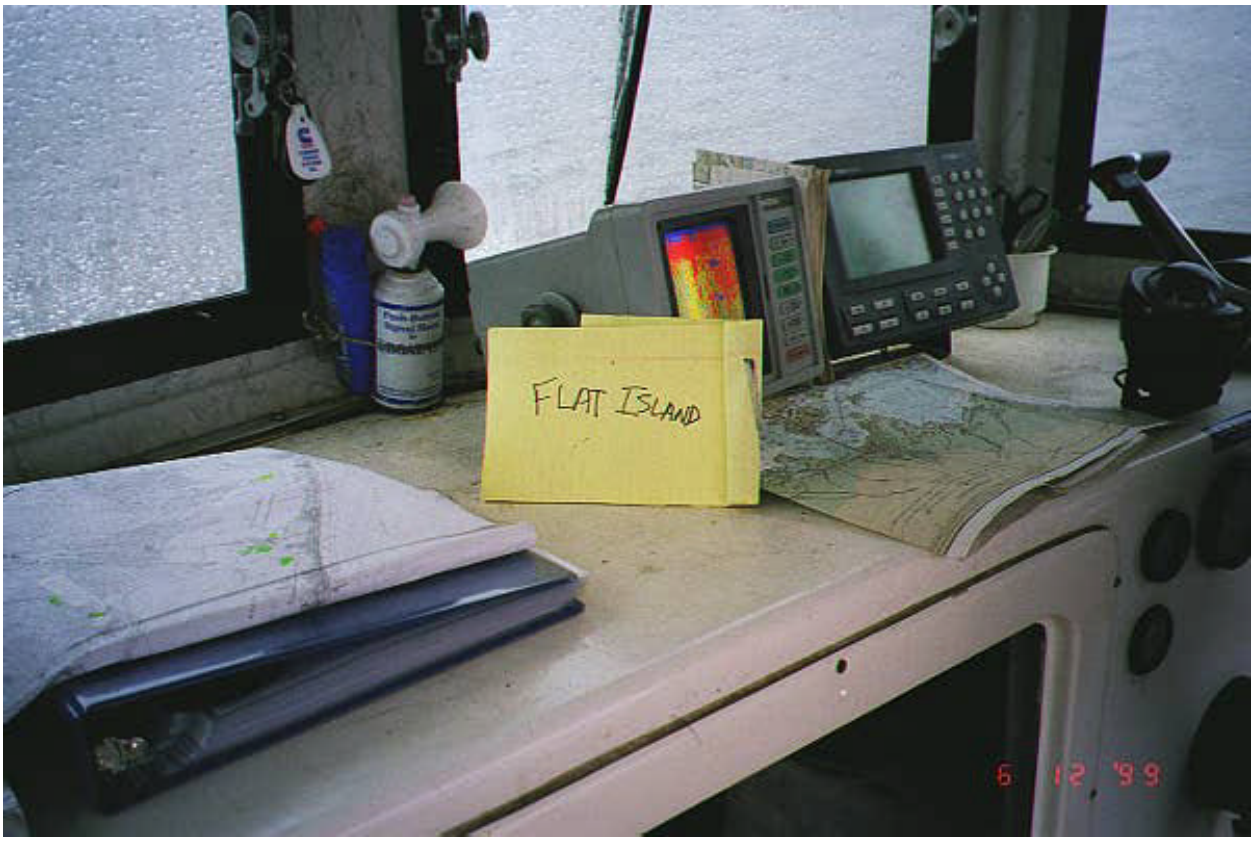
21 12 '99

21 12 '99

21 12 '99

PRE13

28 11 '99


FLAT ISLAND
6 12 '99

6 12 '99

6 12 '99

6 12 '99

6 12 '99

APPENDIX J

Section 5

Environmental Testing and Restoration Proposals

BARNEGAT BAY ECOSYSTEM RESTORATION ENVIRONMENTAL TESTING AND RESTORATION PROPOSALS

DRAFT REPORT

Contract No: DACW61-95-D-0011

Submitted to

Terry Fowler
Coastal Planning Section
Project Development Branch
Barbara Conlin
Environmental Resources Branch
Philadelphia District
U.S. Army Corps of Engineers
100 Penn Square East
Philadelphia, PA 19107-3390

Submitted by

Steve Harriott
Mark Southerland
Versar, Inc.
9200 Rumsey Road
Columbia, MD 21045

7 February 2001

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1.0 INTRODUCTION

This report presents the results of the "Barnegat Bay Ecosystem Restoration Environmental Testing and Restoration Proposals" project conducted by the U.S. Army Corps of Engineers (USACE), Philadelphia District, Planning Division, Coastal Planning Section and Environmental Resources Branch. This project is part of a continuing feasibility study to identify the best ecosystem restoration opportunities in Barnegat Bay. The project team identified a total of 23 sites for further study. These include 12 tidal or nontidal wetlands sites; 3 abandoned lagoons; 4 islands; 1 impoundment on a stream; and 3 submerged aquatic vegetation sites (Table 1-1; Figure 1-1). In addition, USACE and NJDEP are currently studying an additional two dams (Lake Pohatcong and Manahawkin Lake) for potential installation of fish ladders, and two dredged holes in the Bay (hole #5 in Loveladies and hole #6 in Harvey Cedars) to determine opportunities for habitat improvement.

1.1 BACKGROUND

Pursuant to the Congressional resolution on Barnegat Bay, NJ (September 14, 1995), the USACE, Philadelphia District completed an expedited reconnaissance study identifying possible improvements in ecosystem restoration and protection. Specifically, the following problems (and associated restoration objectives) were identified:

1. Ecosystem degradation and habitat loss
   - Freshwater wetlands restoration/creation
   - Salt marsh restoration
   - Restoration of abandoned lagoons
   - Submerged aquatic vegetation (SAV) restoration

2. Fish and wildlife ecosystem degradation
   - Restoration of fishery habitat
   - Waterbird habitat restoration
   - Creation/restoration of islands

Two additional concerns were identified that are not considered primary benefit categories (i.e., the optimization of a proposed project will not depend upon their associated objectives being satisfied):

3. Lack of safe public access to environmentally significant sites
   - Construction of wildlife viewing platforms

4. Bay flooding
   - Flood reduction

The New Jersey Department of Environmental Protection (NJDEP) was identified as a non-Federal sponsor.

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Table 1-1. Summary information for potential restoration sites studied for the Barnegat Bay Ecosystem Restoration Environmental Testing and Restoration Proposals.

Site	Site Type	Size (acres)	Ownership	Approximate Estimated Cost	Restoration Proposed
TWS15 (N. Westecunk Creek)	Tidal Wetland (fresh)	5.28	USFWS	$708,824	Restore 3.1 acres of tidal wetlands by removing fill. Remove phragmites on 2.63 acres.
TWS17 (N. Westecunk Creek)	Tidal Wetland (fresh)	12.37	USFWS	$412,024	Restore 1.6 acres of tidal wetlands by removing fill. Remove phragmites on 14.13 acres.
TWS18 (N. Westecunk Creek)	Tidal Wetland (fresh)	14.79	USFWS	$206,924	Restore 1.8 acres of tidal wetlands by removing fill. Remove phragmites on 4.40 acres.
TWS23 (S. Westecunk Creek)	Tidal Wetland (fresh)	15.88	USFWS	$280,489	Convert 2.37 acres of existing upland phragmites to forested habitats by fill addition, phragmites removal, and re-planting.
TWS24 (S. Westecunk Creek)	Tidal Wetland (fresh)	17.29	USFWS	$804,655	Convert 3.5 acres of existing upland phragmites to forested habitats by fill addition, phragmites removal ,and re-planting.
TWS25 (S. Westecunk Creek)	Tidal Wetland (fresh)	7.21	USFWS	$526,764	Restore 7.2 acres of tidal wetlands by removing fill. Remove phragmites on 7.0 acres.
NWS02 (Stafford Forge WMA)	Nontidal Wetland	527.00	NJDEP	$371,200	Restore anadromous fishery with fish ladders/structures; restore 8 acres of Atlantic white cedar wetlands.
NWS01 (Cedar Run Abandoned Cranberry Bog)	Nontidal Wetland	60.30	USFWS	$19,700	Restore anadromous fishery by removal of water control structure; restore 5 acres of Atlantic white cedar wetlands.
TWS39 (Barnegat Light)	Tidal Wetland	117.00	NJDEP	$366,390	Create 3.5-acre shallow intertidal pond with associated channel and clear vegetation for piping plover habitat. Build pedestrian footbridge over channel.
TWS02 (Ballanger Creek Abandoned Cranberry Bog)	Tidal Wetland (fresh)	22.00	NJDEP	$10,000	Restore Atlantic white cedar wetlands and herbaceous wetlands by removal of berm/beaver dam.
TWC21 (Oyster Creek)	Tidal Wetland	111.00	GPU Energy	$782,807	Restore tidal wetlands in eastern part of the site by re-introducing tidal flow. Improve/expand 8.00 acres of open sandy upland habitat. Eradicate phragmites on approximately 3 acres.
NWS03 (Silver Lake)	Nontidal Wetland	5.23	Private (land access) NJDEP (structure)	$10,020	Re-establish anadromous fishery above this site on Westecunk Creek (see also NWS02). Project would also likely benefit American eel, non-anadromous fish, and benthic organisms.
LAN05 (F-cove abandoned lagoon)	Abandoned Lagoon	16.70	USFWS	$1,428,560	Habitat improvements for important fishery and benthic resources. Establishment of permanent habitat for diamondback terrapins. Improve water quality. Convert two small areas of phragmites to tidal marsh.
LAN06 (L-cove abandoned lagoon)	Abandoned Lagoon	13.00	USFWS	$354,620	Habitat improvements for important fishery and benthic resources. Establishment of 1.7 acres of permanent habitat for diamondback terrapins. Improve water quality. Convert 0.30 of berm to tidal marsh.
LAC02 (Bayville South abandoned lagoon)	Abandoned Lagoon	30.01	Ocean County	$682,345	Habitat improvements for important fishery and benthic resources. Creation/expansion of SAV habitats. Improve water quality. Phragmites removal.
ISS03 (High Island)	Island	11.00	Brant Beach Yacht Club	$1,243,951	Establish 7.3 acres of open, sandy upland habitat for use by beach-nesting birds and diamondback terrapins. Removal of 7.3 acres of phragmites.

Table 1-1. Cont'd.

Site	Site Type	Size (acres)	Ownership	Approximate Estimated Cost	Restoration Proposed
ISS01 (Cedar Bonnet Island)	Island	143.00	USFWS	$729,745	Create 3.0 acres of open, sandy upland habitat for use by beach-nesting birds and diamondback terrapins. Create 2.0 acres of new tidal wetlands from upland phragmites.
ISS08 (Island 26A)	Island	22.00	NJDEP	$746,948	Improve habitats for beach-nesting birds, by removing vegetation and flattening. Implement "gull discouragement" program to encourage nesting of less common species (skimmers, terns, etc.).
ISS02 (Flat Island)	Island	69.00	Flat Island Private Investors Corp.	$920,225	Re-establish 8 acres of tidal marsh by removal of fill materials. Establish 8 acres of new forested and scrub-shrub wetlands with fill materials. Eliminate 10 acres of phragmites.
33-17 (Double Trouble Dam)	Dam/Fish Ladder	1.00	NJDEP	$104,800	Establish an anadromous fishery in Cedar Creek above the Double Trouble Dam by installing a prefabricated-type fish ladder at the dam.

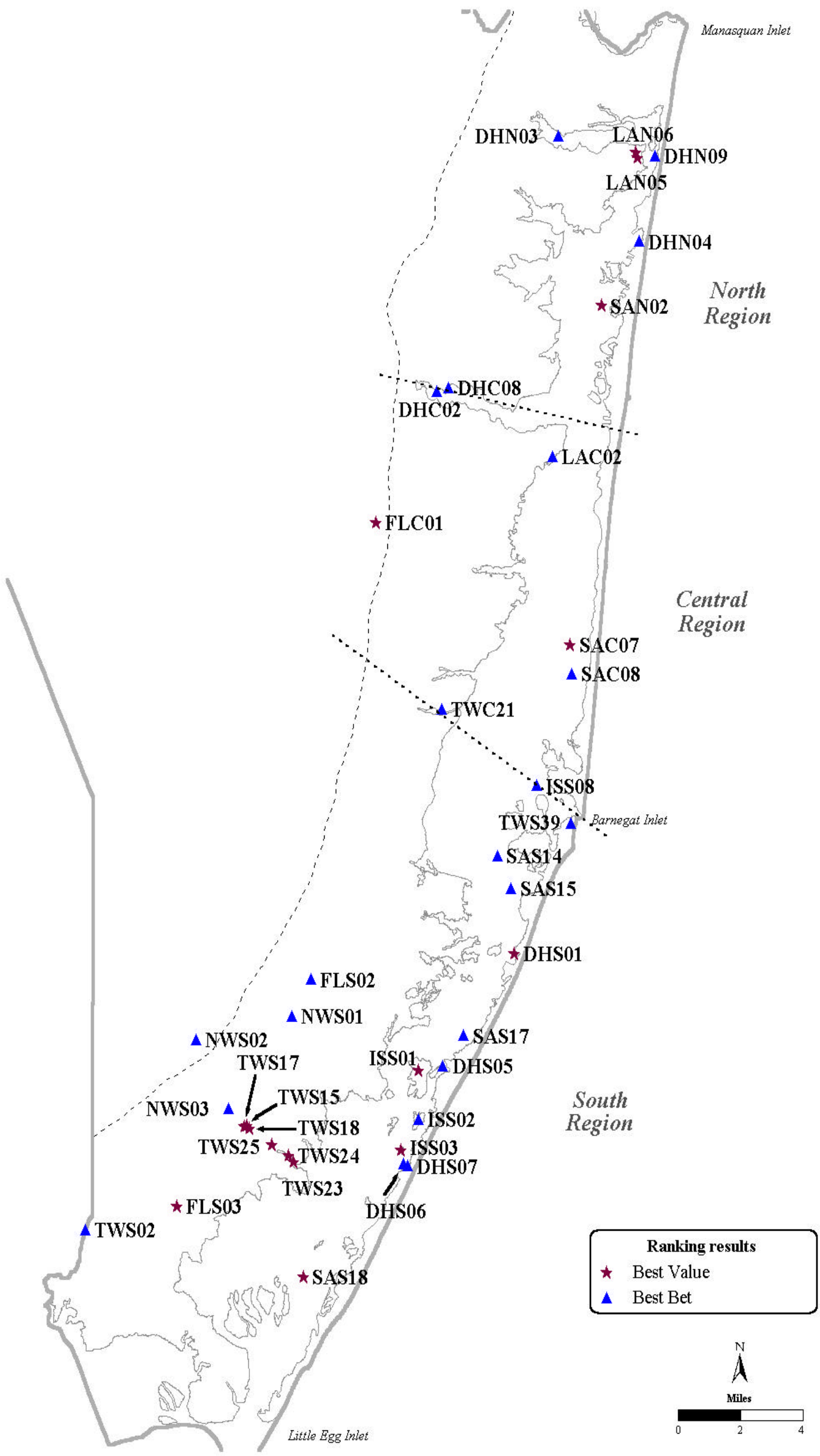

Figure 1-1. Location of the 24 high-priority potential restoration sites within the Barnegat Bay ecosystem.

As the first step in the feasibility study phase, USACE conducted a "Barnegat Bay Ecosystem Restoration Site Selection" project to meet the critical need for identifying specific high-priority restoration sites in the Barnegat Bay ecosystem. This was accomplished by completing comprehensive GIS and field evaluations throughout the study area.

For the purposes of the feasibility study, the Barnegat Bay ecosystem is defined as Barnegat Bay itself and adjacent lands west to the Garden State Parkway (Figure 1-1). This covers approximately 210,000 acres of Ocean County, NJ stretching from Point Pleasant and Bay Head in the north to Beach Haven Inlet in the south, and from Island Beach and Long Beach Island in the east to the Garden State Parkway in the west (Kennish and Lutz 1984). A more detailed description of the study area is provided in the site selection report (USACE 2000). That report also presents the results of the GIS and field evaluations that identified 120 possible restoration sites and subsequently assigned them priorities within each habitat category as restoration opportunities. These evaluations used the following criteria to assign priorities:

- sites with big problems, i.e., those that would produce the greatest benefits if restored
- sites most conducive to restoration, i.e., those most likely to be successfully restored
- sites with fish and wildlife habitat degradation, i.e., those where natural resources would benefit from restoration that would be sustainable over time
- sites whose restoration would benefit a large geographic region, i.e., those whose ecological linkages would most benefit ecosystem restoration
- sites within the Federal interest
- sites within the interest of the non-Federal sponsor

1.2 GOALS AND OBJECTIVES

The goal of this environmental testing project is to refine the conceptual plans for each of the 20 high-priority restoration sites through (1) extensive coordination with interested agencies and experts and (2) intensive field investigations at each site. More specifically, the objectives of the project are to

- Complete thorough field studies and mapping of site characteristics
- Develop detailed restoration concepts for each site
- Identify potential environmental impacts and constraints on restoration
- Prepare general cost estimates for each restoration
- Conduct coordination to identify partnerships and refine restoration plans

1.3 ROADMAP TO THIS REPORT

This report presents the results of the Barnegat Bay Ecosystem Restoration Environmental Testing and Restoration Proposals project. Following the introduction, the methods used in the field investigations are described. Then a short section summarizing the range of environmental problems encountered and the kinds of restoration concepts proposed is presented. The main part of the report comprises detailed discussions of each restoration site, including

- Site description and ownership
- Vegetation and land cover
- Water quality
- Wildlife
- Environmental problems present at the site
- Restoration constraints and other site information
- Restoration concept
- Project implementation
- Potential environmental impacts
- Estimated costs

Appendix A contains individual comments and meeting minutes from the coordination phase of the project. Appendix B contains the field data sheets for all 20 visited sites. Appendix C contains site photographs.

2.0 METHODS

The following methods were used to thoroughly characterize 20 of the 23 high-priority restoration sites (no field investigations were conducted for the SAV sites). Because of uncertain environmental problems relating to SAV (especially wasting disease, changing water quality, and other factors), no field investigations were conducted for the SAV sites. More detailed data and information relating to these problems must be collected prior to preparation of plans for the SAV sites. The results of applying these field methods are presented in later sections of this report.

2.1 VEGETATION AND LAND COVER

Vegetation and land cover were systematically mapped during the field investigations at each of the 20 Barnegat Bay restoration sites. A series of recent, orthographically-rectified, low altitude, vertical, black and white aerial photographs was prepared for each of the sites (USACE 1998). Typically, two aerial photographs were prepared for each site, one intended to give overall perspective and another to provide greater detail on specific areas of the site (as many as four photographs were prepared for the largest sites). Each of the aerial photographs was laminated and sealed in a clear 3-mil plastic coating to prevent stretching and weather damage, and to allow for mapping directly on the photographs with narrow tipped permanent markers.

Prior to walking a site, the aerial photographs were studied for initial identification of all potential vegetation and land cover types existing at the site. Each of the sites was then thoroughly traversed (conditions permitting) by a team of experienced wetland botanists, biologists, ecologists, and wildlife scientists (note that each of these sites had previously been visited during the field phase of the site selection project and was thus familiar to the field crew). Detailed notes were prepared on each of the vegetation and land cover types observed at the site using resource type-specific data sheets (including information such as species composition, size of dominant vegetation, rare or infrequent species, wildlife use, etc.; refer to Appendix B for copies of data sheets). Numerous ground-level, color photographs were taken during the site studies.

After ensuring that the team was familiar with all on-site vegetation and land cover types, we mapped site features directly on the aerial photographs in the field. Each field team member then reviewed the completed draft map, making minor revisions where necessary.

The field vegetation and land cover mapping on the [marked-up] aerial photographs was then digitized directly into a geographic information system (GIS) using ArcView. The resulting figures were then produced at the most appropriate scale, based on the size of the site (these figures are provided in the site characterization summaries in later sections of the report).

2.2 WATER QUALITY

Surface water quality data were collected to provide basic information on potential restoration options at the sites (e.g., whether an adjacent tidal waterway is sufficiently saline to remove phragmites if a connection was established). The monitoring was not intended to characterize long-term trends or complete water quality conditions at the sites. Data were collected at several different depths, where appropriate. The water quality data were transcribed from the Yellow Springs Instrument Company (YSI) unit onto tables on the site data sheets. Parameters measured included pH (pH units), salinity (0/00), dissolved oxygen (mg/L), specific conductivity (mS/cm), temperature (°C), and turbidity (NTU). Measurements were often taken in several locations at the sites, as well as upstream and downstream, where appropriate.

In-situ water quality measurements were made using a YSI model 6820 multiparameter sonde. The sonde was torpedo shaped and equipped with probes that measure dissolved oxygen, conductivity/specific conductance, pH, temperature, salinity, and turbidity. We used 100% saturation to calibrate dissolved oxygen, 0.01N KCl solution to calibrate specific conductance, pH 7 and 4 buffers to calibrate pH, and 100 NTU solution to calibrate turbidity.

2.3 SITE-SPECIFIC MEASUREMENTS AND MISCELLANEOUS INFORMATION

Additional direct measurements, such as heights and lengths of berms, depth of fill to surrounding wetlands, size of water control structures, elevation of pond level above existing streams, width of fill roads, and other important information were collected where possible at the sites. Many of these features were measured directly with a 300-foot reel-type fiberglass measuring tape. Where it was not possible to directly measure such features (i.e., where it would have been too dangerous or impractical to do so) their dimensions were estimated, based on areas of the feature that were visible and/or accessible during the field studies. Substrates of fill materials at each of the sites were characterized as sand, silt, clay, or combinations. At the three abandoned lagoon sites (LAC02, LAN05, and TWS39), a rough bathymetric survey and substrate characterization was performed using electronic boat-mounted depth finders (calibrated to a depth of +/- 1 foot) and a Ponar grab substrate sampler. The lagoon bottom substrate was categorized as sand, silt, mud, or a combination. In addition, fish communities were surveyed by performing beach seining in appropriate locations with a 50-foot net. A 100-foot experimental gill net was also employed at LAN05 to determine whether adult fish inhabit this lagoon. The gill net was only used at this location because of the site's direct and deep connection with Barnegat Bay; LAC02 is land-locked and LAN06 is only indirectly connected to Barnegat Bay through narrow, shallow ditches. Detailed notes and drawings of all features were recorded on the site-specific data sheets.

2.4 WILDLIFE

The field team recorded all observations of terrestrial and aquatic wildlife and their signs during the field studies at each of the 20 Barnegat restoration sites. Only passive means were

used to collect information on existing wildlife; no trapping was performed at any of the sites. Efforts were made not to disturb breeding wildlife during the studies. Binoculars were employed for observation of aquatic and terrestrial birds and distant direct sightings of wildlife. Signs of wildlife included the presence of tracks, dens, burrows, current nests, scats, calls, etc. Detailed notes were recorded describing where each species or its signs was observed, whether it appeared to breed on the site, and, where appropriate, how it apparently uses the site. Anecdotal information on wildlife from conversations with area was also noted.

2.5 PHYSICAL STREAM HABITATS

The physical stream channel habitats adjacent to 5 of the 20 sites were evaluated using a qualitative process (refer to Appendix B for data sheets). A qualitative habitat assessment for low gradient streams was used to evaluate the physical stream habitat, using rapid assessment protocols (Plafkin et al. 1989 as updated by Barbour and Stribling 1994). Characteristics in the assessment were: instream cover (fish), epifaunal substrate, embeddedness, channel alteration, sediment deposition, frequency of riffles, channel flow status, bank vegetative protection (left and right), bank stability (left and right), and riparian vegetative zone (left and right). An assessment of benthic macroinvertebrates was made at each stream sampling reach by inspection of appropriate substrates (e.g., submerged rocks, logs, sticks). Surface water quality was also monitored at each of the stream habitat assessment stations (refer to Water Quality, above).

2.6 COST ESTIMATES

The field investigation methods described above were not done to survey-grade specifications and therefore cannot be used to develop precise cost estimates for proposed restoration activities. Nonetheless, reasonably accurate cost estimates for the types of restoration under consideration are an important part of the feasibility process. Therefore, the following assumptions were used for estimating costs at each restoration site. They address the two main activities involved in the proposed restoration concepts: removal of phragmites and earthmoving (including dredging, transport of dredged material, and earthwork). The estimated range of costs was based on February 2001 price levels.

Phragmites removal. The USFWS, the NJDEP, and other area environmental agencies use both fixed-wing and helicopter aircraft for herbicide application to remove phragmites in the vicinity of the study area. They have reported success in aerial application of herbicides using Bell 47G helicopters equipped with Simple spraying systems and size 3 and 5 Raindrop nozzles (fixed-wing craft utilize similar spraying systems). They also utilize Through Valve Booms when low herbicide drift is mandatory (personal communications, Eric Schrading, USFWS; Suzanne Dietrick, NJDEP; Rob Hossler, Delaware Department of Natural Resources and Environmental Control). Similar equipment should be employed for the Barnegat projects.

Based on interviews with agency personnel, the cost of herbicide treatments to eradicate phragmites ranges from about $12 to $80 per acre. This cost includes helicopter or fixed-wing

aircraft operation and all herbicide and surfactant costs, and is based on an application rate of four pints of herbicide per acre treated. Additionally, nominal one-time deployment costs could apply for use of the helicopter or fixed-wing aircraft (personal communications, Rob Hossler, Delaware Department of Natural Resources and Environmental Control and Eric Schrading, U.S. Fish and Wildlife Service). Costs vary greatly, owing primarily to "economies of scale." Large sites (or combinations of adjacent sites) sprayed by fixed-wing craft are typically the least expensive. Small, one-time sites that require a helicopter are typically the most expensive (personal communication, Eric Schrading, USFWS).

In addition, the cost of hand application (by personal backpack devices) of herbicide for small sites, sensitive areas, and follow-up treatments could range from approximately $100 to $800 per acre (depending upon the particular scenario), plus materials (personal communications, John Ronafalvy, PSEG; Eric Schrading, USFWS).

"Aquatic Pesticide Permits," issued by NJDEP, Pesticide Control Program would be required for all the large-scale herbicide applications in the Barnegat projects. The spray permits are typically issued under a pesticide license maintained by the pilot or airport supplying the aircraft (personal communication, Eric Schrading, USFWS).

Dredging operations, transport of dredged materials, and earthwork. According to the NJDEP, Division of Engineering & Construction (the State agency responsible for maintenance dredging of Barnegat Bay waterways), costs for earthmoving would range from approximately $35 to $40 per cubic yard of sandy materials to be excavated or moved (personal communication, Bill Dixon, NJDEP). Other costs might also apply for application and spreading the materials at a site. Earth-moving equipment costs could range from $300 to $500 per day, depending on site-specific requirements and constraints.

3.0 ENVIRONMENTAL PROBLEMS ENCOUNTERED AND RESTORATION CONCEPTS PROPOSED

This section briefly describes the range of environmental problems encountered at the 20 high-priority restoration sites and presents the general kinds of restoration concepts proposed to address each problem. This general discussion sets the stage for the detailed characterizations and individual restoration concepts presented for each site in the remainder of the report.

3.1 LOSS OF HABITAT FROM FILLING AND DREDGING ACTIVITIES

Valuable ecological habitat in the Barnegat Bay ecosystem has been lost through extensive filling and dredging activities associated with human development. Removal or burial of habitats by earthmoving activities is the most direct way to eliminate habitat. Tidal marshes, in particular, have suffered historically as a result of filling for construction, excavations for channel/lagoon access to communities, and disposal of dredged and other fill materials. Large areas of tidal marsh were once characteristic of the Barnegat Bay ecosystem; today many former marshes have been converted to uplands (by filling) or open water (by dredging). Most of these activities occurred prior to enactment of wetland legislation in New Jersey (i.e., NJ Wetlands Act of 1970; NJ Freshwater Wetlands Protection Act of 1987). Historical dredging has also resulted in the loss of aquatic habitats (but note that dredged holes are not being addressed in this report). Uplands have also been altered (at least temporarily) by the placement of fill material. Beach environments, in particular, have been replaced by housing and human activity (resulting in loss of bird nesting habitat). Wherever the original habitat has been lost, there is the potential for affecting wildlife, including rare, threatened, and endangered species.

Restoration of these lost habitats essentially falls to removal of fill material and filling of dredged channels and holes. While conceptually simple, such restoration needs to carefully address the effects on hydrology and species that have adapted to the altered environment. Especially in the case of wetlands, the resultant elevation and hydrological regime is what determines whether the original or desired habitat will become established (Zedler et al. 2000; see the next problem area below).

3.2 LOSS OF HABITAT FROM HYDROLOGICAL MODIFICATIONS

Valuable ecological habitat in the Barnegat Bay ecosystem has also been lost as a result of more subtle changes in the hydrologic regime. In some instances it is the amount and timing of water flow; in others it is the mix of freshwater and saltwater inputs. The construction of dams and dikes has flooded stream, wetland, and upland habitats, creating open water lakes for recreation and bogs for cranberry production. These water control structures also serve as barriers to anadromous (e.g., herring), catadromous (e.g., American eel), and resident fish populations. The dredging of even small channels (e.g., mosquito ditches) has drained water from marshes and converted them to uplands or different vegetative communities. In particular,

Atlantic white cedar wetland communities have declined as the hydrological patterns have changed. Restoration of this community is a priority among natural resource agencies in the area. At the same time, changes in coastal hydrology (through the hardening of shorelines, using bulkheads, stone revetments, etc.) has eliminated much of the sandy habitat used by beach nesting birds. As above, the loss of original habitat can adversely affect wildlife, including rare, threatened, and endangered species.

Restoration of these altered habitats requires restoration of the natural hydrologic regime; natural hydrology is most often restored by reinstitution of the original elevation. Restoration activities include the breaching or removal of dams and dikes, and the reestablishment or reconfiguring of hydrological flows (e.g., tidal influence). While reinstitution of the historical hydrology will generally result in the return of the original vegetation, plantings of desired species can be used to facilitate restoration. Where dams cannot be removed, fish passage structures can be added. Mosquito control is now using open marsh water management, which involves different hydrological patterns (potentially favorable to marsh restoration).

3.3 INVASION OF HABITATS BY PHRAGMITES

Phragmites australis (phragmites) is an invasive plant that frequently forms dense monotypic stands in disturbed areas. Many such areas occur in the Barnegat Bay ecosystem. While it is presumed that phragmites has always been a minor component of the flora in the region, the placement of fill, alteration of hydrology, and disturbance of substrates in Barnegat Bay have allowed phragmites to outcompete and replace more ecologically valuable plant communities. In general, phragmites will first colonize along the wet edges of disturbed sites and expand outward. This is particularly true in tidal marshes, where phragmites is not exposed to salinities greater than about 18 parts per thousand (its physiological limit). While phragmites marshes may perform some of the same physical functions as natural wetlands (e.g., flood control, water purification, erosion control), they shade out and exclude rarer plants, and apparently provide very few amenities for wildlife in the form of food, cover, and breeding habitats. Once fully established at a site, phragmites may persist as a "virtual climax" community, effectively eliminating invasion by more desirable species. Dense phragmites marshes can also be dangerous fire hazards where they are close to houses and other buildings (This is frequently the case in the densely-populated Barnegat Bay area).

Restoration of habitats invaded by phragmites requires that the existing phragmites be killed (particularly the living rhizomes) with herbicides and reinvasion be prevented. Aerial and ground application of herbicides have proven successful in eliminating phragmites and techniques have been refined in recent years. The best way to prevent reinvasion is to change the hydrological and substrate conditions that favored the invasion. Specifically, a tidal influence (bringing saltier water) can prevent reinvasion or eliminate phragmites. Replacement of wet areas with well-draining substrates will slow reinvasion, especially if a layer of crushed shell is applied.

3.4 DEGRADATION OF WATER QUALITY

At the same time that human development has been accelerating in the Barnegat Bay ecosystem, the inputs of pollutants (especially from nonpoint sources) have increased. Coupled with the changes in the land and hydrology, these inputs have substantially degraded water quality. The input of nutrients and sediment to the estuary has reduced water clarity and eliminated SAV from much of the Barnegat Bay ecosystem (Kennish and Lutz 1984). Water quality in the western part of the Bay is not likely to support large areas of SAV because of several factors, including high light attenuation owing to sediment loads (not good for any SAV growth), and low salinity (not good for eel grass, but good for other species such as widgeon grass). Wasting disease (apparently linked to degraded water quality as well as other factors, such as climate and rainfall) has also played a part in lowering SAV density in the Bay (personal communication, Paul Bologna, Rutgers University). Water quality is particularly degraded in the altered habitats created by the human activities discussed above. For example, some abandoned lagoons originally dredged as part of planned residential development have low dissolved oxygen and poor habitat. Those with greater hydrological connections generally have better water quality and support more species.

Restoration of water quality is to a large extent beyond the capabilities of the Barnegat Bay Ecosystem Restoration project. Reductions in nonpoint source inputs to the estuary and its tributaries require the cooperation of many partners and private citizens, an issue currently being addressed by the Barnegat Bay Estuary Program. Water quality problems at specific sites can be addressed to a certain degree when reestablishment of a tidal connection would benefit desired species. This may be the case for artificial landlocked lagoons. Restoration opportunities for other habitats are likely greater where water quality is not a limiting factor (e.g., for SAV) and this has been taken into consideration when identifying the 24 high-priority restoration sites.

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4.0 ENVIRONMENTAL TESTING INFORMATION AND RESTORATION PROPOSAL FOR WETLAND RESTORATION SITES

Refer to Figure 1-1 for location of sites within study area.

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4.1 SITE TWS15 (NORTH WESTECUNK CREEK)

4.1.1 Site Description and Ownership

Site TWS15 is owned by the USFWS and is included within the Edwin B. Forsythe refuge system. It is located approximately 1 mile south of West Creek, New Jersey, on the north side of Westecunk Creek, and is partially visible from West Creek Dock Road. The fill area of the site is roughly rectangular, oriented in an essentially north-south direction, and is a total of approximately 3.1 acres. The site consists of old, coarse sandy material that was apparently side-cast during dredging operations on Westecunk Creek. Site TWS17 is located directly to the west; site TWS18 is located directly to the southeast (separated by a small, unnamed north-south tidal creek).

Substrate corings taken at several locations on the site indicate that the fill is about 4 feet deep throughout, with a maximum depth of approximately 6 feet (taken from a direct measurement) and consists entirely of coarse to medium sand (refer to Appendix B, field data sheets). Depth to groundwater at the coring locations is an average of about 14 inches from the surface. Based on an average fill depth of 4 feet and a measured fill area of 135,465 square feet (821 feet X 165 feet), a total of approximately 20,069 cubic yards (541,860 cubic feet) of sandy material exist at the site (this includes several small higher areas and several small lower areas on the site.)

4.1.2 Vegetation and Land Cover

The site is bordered to the north and east by a small, shallow, unnamed natural tidal creek and to the south by Westecunk Creek. The center of the site is an open sand and shrubby edge community with small red cedar (*Juniperus virginiana*) and red maple (*Acer rubrum*) trees, and an understory of poison ivy (*Toxicodendron radicans*), switchgrass (*Panicum virgatum*), bromegrass (*Bromus tectorum*), and phragmites (*Phragmites australis*) (areas 3 and 4; Figure 4-1). Beyond the shrubby edge on all sides of the site is a dense, monotypic stand of phragmites (*Phragmites australis*) (area 1; Figure 4-1). Off the site to the northeast, northwest, and north is brackish to freshwater marsh that is dominated by threesquare (*Scirpus pungens*), big cordgrass (*Spartina cynosuroides*), narrow leaved cattail (*Typha angustifolia*), swamp rose mallow (*Hybiscus moscheutos*), and high tide bush (*Iva frutescens*). In addition, some smaller, apparently more saline areas are dominated by saltwater cordgrass (*Spartina alterniflora)* and salt hay (*Spartina patens*).

TWS15A. View looking north at fill area on site TWS15. Note general lack of vegetation on the fill, and the tidal marsh beyond the site in the mid-ground of the photograph.

TWS15B. View looking southeast through fill area of TWS15. The photograph was taken during field studies to determine the depth of the fill.

TWS15C. View looking north at TWS15 from Westecunk Creek. Note the dense growth of phragmites, and the presence of a natural tidal gut.

In general, the suite of vegetation on the fill site proper is of very low diversity compared with areas immediately to the north, east, and west. The freshwater wetlands immediately adjacent to the site are notable, both in their vegetative diversity and in the fact that they are relatively undisturbed (only minimal ditching). Further, the area of these three related sites is drained by several apparently natural (i.e., not dredged or otherwise altered by mosquito commission activities) tidal creeks. The undisturbed nature of the marshes likely indicates that they possess a fairly natural tidal wetlands hydrology. This situation is contrasted with the heavily ditched tidal marshes to the south of these sites along Westecunk Creek, where the marshes are far less diverse.

4.1.3 Water Quality

Surface water quality was measured in several locations on Westecunk Creek and on the small unnamed adjacent tidal creeks during the field studies (refer to Section 1 for a description of the equipment used); Table 4-1 presents results. The results for all measured parameters were typical of local waterways in the study area; only the salinity was notable. First, upper Westecunk Creek in the vicinity of the three sites was stratified with the upper several feet of the Creek being fresh (less than 1 part per thousand salinity) and the lower part to the bottom much more saline (order of 13 parts per thousand). Second, the small tidal creeks adjacent to the sites were moderately saline, ranging from about 3 parts per thousand to nearly 7 parts per thousand. Overall, the salinity of Westecunk Creek ranged from less than 1 part per thousand near the sites to 24 parts per thousand near the mouth of the Creek.

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Figure 4-1. Vegetation and land cover of site TWS15. Features were drawn in the field directly onto recent low-altitude, black and white, digitally rectified aerial photographs (USACE 1998). Wetlands vegetation and land cover types are indicated by an asterisk (*) in the legend.

Table 4-1. Results of water quality testing done at Site TWS15 for the Barnegat Environmental Testing field studies.

Sampling Location	pH	Salinity (o/oo)	D.O. (mg/L)	Specific Conductivity (mS/cm)	Temp (°C)	Turbidity (NTU)
W1 (West Creek main channel at site; surface)	7.12	0.71	7.54	1.349	19.92	25.1
W2 (tidal creek to east of site; 3ft.)	6.50	3.02	6.48	5.553	20.75	48.5
W3 (tidal creek to E of TWS18; 1ft.)	6.45	6.71	6.12	11.72	20.66	24.7
W4 (West Creek, near TWS24; 4ft.)	6.45	18.30	3.89	29.35	21.33	26.3
W5 (West Creek, at mouth; 6ft.)	7.20	24.10	7.92	38.04	20.87	80.3

4.1.4 Wildlife

Wildlife and their signs (tracks, scats, calls, and other identifiable physical evidence) that were observed during the field studies included raccoon (*Procyon lotor*), white-tailed deer (*Odocoileus virginianus*), marsh wren (*Cistothorus palustris*), and diamondback terrapin (*Malaclemys terrapin terrapin*). It would also be noted that several current muskrat (*Ondatra zibethicus*) dens were observed off the site to the northwest (in the non-phragmites marsh to the far northwest of the site; no evidence of muskrats was noted near the site). Many raccoon scats were observed, particularly in the vicinity of the small tidal creek to the east of the site (it was noted that the scats appeared to be composed entirely of crab shell). White-tailed deer tracks crossed most of the site (no direct sightings were made). Marsh wrens (most individuals observed were singing males) were observed along the small tidal creek to the north and east of the site. The evidence for diamondback terrapin was limited to one scrape; it was apparently not recent. In addition, domestic dog tracks were noted in many areas of the site.

In general, none of these three related habitats appear to be valuable to wildlife. The open, sandy habitats appear to be frequented by domestic dogs. The small red cedar trees along the edges of the site are widely-spaced and do not provide the same quality of habitat for nesting birds as a forest. The phragmites marsh encircling the site is dense and does not appear to be used by wildlife, other than for temporary cover.

4.1.5 Environmental Problems at the Site

<u>Loss of Habitat from Dredging and Filling</u>

The site includes a large area of fill material that has eliminated a valuable freshwater tidal marsh habitat. The fill at the site covers approximately 3.1 acres; one can assume that the same area of historic tidal marsh was lost as a result of this placement of fill (fill area is 821 ft. X 165 ft. = 135,465 ft.^{2} = 3.1 acres). Based on the more diverse vegetation area found adjacent to the site, the fill evidently covered and eliminated relatively undisturbed, ecologically important

freshwater tidal marsh. The placement of the fill also resulted in other related ecological problems, such as invasion by phragmites.

Dominance by Phragmites

Most of the area immediately surrounding the outer edges of the sandy fill at this site is covered by a dense monoculture of phragmites (total of 2.63 acres). It is presumed that while phragmites was always a minor part of the vegetation at all three north Westecunk Creek sites, the placement of fill allowed the existing phragmites to colonize first along its (wet) edges and then to expand outward throughout the marsh. The dense monoculture of phragmites has replaced the more ecologically valuable original tidal marsh plant communities. It appears that phragmites is still colonizing the marsh to the west of the site (north of site TWS17), where a mixture of phragmites and threesquare marsh is present.

4.1.6 Restoration Constraints and Other Site Information

Virtually all of the land on the north side of Westecunk Creek in the vicinity of the site is tidal marsh; on the south side of the Creek is West Creek Dock Road and residences. Residences are present within about 150 to 200 feet of all three of the north Westecunk Creek sites. Because of the close proximity of these houses, spraying of herbicides for phragmites control will have to be coordinated with local residents. "Aquatic Pesticide Permits," issued by NJDEP, Pesticide Control Program would be required for all the large-scale herbicide applications in the Barnegat projects. The spray permits are typically issued under a pesticide license maintained by the pilot or airport supplying the aircraft (personal communication, Eric Schrading, USFWS). In addition, the prescribed burning recommended at this site would also likely require a permit from the New Jersey Forest Fire Service.

No other potential constraints on implementation of these projects have been identified to date. During the field studies, no submerged aquatic vegetation was observed in Westecunk Creek or in the small, unnamed tidal creeks in the vicinity of the sites.

According to the USFWS draft Forsythe National Wildlife Refuge management plan (USFWS 2000), these sites are slated for restoration. The NJDEP Engineering and Construction office has stated that the north Westecunk Creek sites will not be needed for dredged material disposal in the future (Bill Dixon, NJDEP, personal communication). At this time, therefore, we see no obvious conflicts with other planned management at these sites.

4.1.7 Restoration Concept

The restoration action proposed at TWS15 includes (1) removal of the approximately 20,000 cubic yards of sandy dredged fill material from the site and (2) eradication of phragmites. The fill removal would directly restore 3.1 acres of freshwater tidal marsh by reestablishing the proper hydrologic regime and substrate to the marsh. Phragmites eradication would restore at least 2.6 acres of native marsh vegetation at the site. The phragmites eradication would best be accomplished by aerial spraying of an herbicide agent containing glyphosate that is EPA-registered for use in aquatic and semi-aquatic environments. It is assumed that the marsh

restoration would encourage re-growth of a suite of vegetation similar to that in the adjacent "unaffected marsh" (cordgrasses, bulrushes, swamp rose mallow, etc.; refer to Vegetation and Land Cover section, above). Success at similar tidal restoration sites was recently described in Zedler (2000), where vegetation successfully colonized with little or no planting, from adjacent wetlands and the tide. The project would foster ecosystem diversity by replacing a relatively monotypic system (phragmites) that likely possesses little overall value to area wildlife with a diverse freshwater wetland system that is increasingly rare in the study area.

4.1.8 Project Implementation

The project would be implemented in the fall and winter of the year (refer to next paragraph on phragmites removal). The approximately 20,000 cubic yards of sandy material could be removed from the site using a small bulldozer, backhoe, or similar piece of equipment. The equipment would likely have to be brought in by barge or similar craft to the site at its southeastern-most end, where the fill extends to about 50 feet north of Westecunk Creek. The equipment could be brought in over bog mats or similar structures to help protect this part of the phragmites marsh from excessive compaction. Access to the site by equipment would be limited to one point to minimize impacts to the existing phragmites marsh. Once the equipment has reached the site, the small amount of woody vegetation (primarily small red cedar trees) could be easily removed and barged/boated away for disposal (these stumps, brush, and other materials could potentially be used as amenities for wildlife at other sites). The clean fill material would then be excavated to the original marsh surface (approximately 4 vertical feet of material). The excavating work would be performed from north to south.

Immediately after the fill material has been excavated from the site, the phragmites eradication would take place. For maximum herbicide effect, spraying of the phragmites would take place from early to mid-September. The herbicide is most effective when the transport of the photosynthesized sugars from the leaves of the plants to its rhizomes is maximized, reportedly during this time of year. Because the site is open, spraying could be accomplished either by fixed-wing craft or by helicopter (costs may be significantly lower with fixed-wing craft). For maximum success, all 14 acres of phragmites at the three north Westecunk Creek sites would be sprayed at one time (or on successive days). Proper care must be taken to closely follow all manufacturer application and safety guidelines, particularly regarding appropriate wind and weather conditions. The dead phragmites stands would then be control-burned in the winter to remove dead standing canes (winter burning maximizes the number of dead phragmites canes) and to enhance the success of follow-up herbicide treatments. It is recommended that follow-up aerial herbicide and burning treatments be made with the same timing (i.e., early autumn herbicide treatment and winter burning) over at least three successive years. In addition, site inspections must be made beginning in late spring after the first aerial application to monitor the success of the phragmites eradication. Phragmites areas that remain after several treatments must be noted and hand-sprayed with backpack sprayers or similar devices.

Monitoring and maintenance of the sites would involve a semi-annual inspection over at least three consecutive years to monitor re-growth (if any) of phragmites at the sites. Remaining phragmites stands would be mapped at this time, so that successive aerial or hand applications of herbicide can be reapplied.

4.1.9 Potential Environmental Impacts

It is estimated that environmental impacts resulting from implementation of the three related projects (TWS15, TWS17, and TWS18) will be primarily restricted to the loss of a very small amount of non-phragmites marsh vegetation on the peripheries of the sprayed areas. Herbicides containing glyphosate are non-selective, and will slowly kill virtually all vegetation that they contact. Such losses will be minimized by selecting the most appropriate spray equipment (e.g., spray nozzles, booms) and using it during optimal atmospheric conditions. Applied correctly in the appropriate concentrations, the herbicide is not expected to cause any negative effects to existing invertebrates, fish, and wildlife currently using the sites.

Additional temporary impacts to the existing phragmites marsh on the southern end of the site may occur as the earth moving equipment is deployed on the site. These effects, however, will be minimized with the use of appropriate protective devices (e.g., bog mats). Appropriate use of erosion and sediment control measures (e.g., silt fences, temporary berms, biologs, etc.) would minimize sedimentation impacts to the adjacent tidal marsh and other sensitive areas during the construction work.

Implementation of the project would not likely result in any additional significant positive or negative impacts relating to air quality and noise levels, water quality, wetlands and other special aquatic areas, finfish (including Essential Fish Habitat), wildlife resources (including, but not limited to, the target species that have been identified), or threatened and endangered species.

4.1.10 Estimated Costs

The following estimated costs include all elements of project implementation at site TWS15, as stated above. The costs listed are approximate, subject to change, and only intended to indicate the relative magnitude of the project. Note that where a range of costs for each item was available, the maximum cost was used. It must also be noted that the clean, sandy materials removed from these three related sites could potentially be used as raw material for restoration actions at one or more of the other selected Barnegat sites to defray costs (for example, this material could be deposited at ISS03 for creating beach-nesting bird habitats).

Sandy material excavation/transportation/spreading/disposal:
20,000 cubic yards @ $35.00 per c.y. = $700,000

Phragmites eradication:
Aerial herbicide: 2.63 acres @ $79.00 per acre = $208.00 X 3 treatments = $624.00
Controlled burns: $800.00 X 3 visits = $2,400.00

Materials:
Bog mat = $1,000.00

Monitoring and maintenance:
Phragmites mapping/backpack spraying: $800.00 X 6 visits = $4,800.00

GRAND TOTAL = $708,824

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4.2 SITE TWS17 (NORTH WESTECUNK CREEK)

4.2.1 Site Description and Ownership

Site TWS17 is owned by the USFWS and is included within the Edwin B. Forsythe refuge system. It is located approximately 1 mile south of West Creek, New Jersey, on the north side of Westecunk Creek, and is partially visible from West Creek Dock Road. As with site TWS15, the fill area is roughly rectangular, oriented in an essentially north-south direction, and is a total of approximately 1.6 acres. The site consists of old, coarse sandy material that was apparently side-cast during adjacent dredging operations on Westecunk Creek. Site TWS17 is located directly to the west of site TWS15; site 18 is directly east of TWS15.

Substrate corings taken at several locations on the site indicate that the fill is an average of about 4.5 feet deep throughout, with a maximum depth of approximately 5 feet (taken from a direct measurement) and it consists entirely of coarse to medium sand (refer to Appendix B, field data sheets). Depth to groundwater at the coring locations was an average of about 30 inches from the surface. Based on an average fill depth of 4.5 feet and a measured fill area of 69,120 square feet (360 feet X 192 feet), a total of approximately 11,520 cubic yards (311,040 cubic feet) of sandy material exist at the site (several small high areas and several small lower areas exist on the site, but these average out).

4.2.2 Vegetation and Land Cover

The site is bordered to the west and the north by a small, shallow, unnamed natural tidal creek, and to the south by Westecunk Creek. The vegetation and land cover at the site is centered of an open sand and shrubby edge community with small red cedar (*Juniperus virginiana*) and red maple (*Acer rubrum*) trees and an understory of poison ivy (*Toxicodendron radicans*), switchgrass (*Panicum virgatum*), bromegrass (*Bromus tectorum*), and phragmites (*Phragmites australis*) (areas 7 and 8; Figure 4-2). Beyond the shrubby edge is a monotypic, dense stand of phragmites (*Phragmites australis*) on all sides of the site (area 2; Figure 4-2). Beyond the phragmites, this site is bordered to the east, west, and north by brackish to fresh marsh that is dominated by threesquare (*Scirpus pungens*), big cordgrass (*Spartina cynosuroides*), narrow leaved cattail (*Typha angustifolia*), swamp rose mallow (*Hybiscus moscheutos*), and high tide bush (*Iva frutescens*). In addition, some smaller, apparently more

TWS17A. View looking northeast through part of the fill area at TWS17. Note the general lack of vegetation on the fill. The photograph was taken during field studies to determine the depth of the fill.

TWS17B. View looking at freshwater tidal threesquare marsh to the north of the fill area at TWS17. Note the general lackof phragmites in this area.

TWS17

Map features [acres]

* 1 = Big Cordgrass/Iva/Phragmites marsh [0.91]
* 2 = Phragmites-wet [7.10]
* 3 = Threesquare marsh [0.87]
* 4 = NL Cattail/Threesquare marsh [1.40]
* 5 = Big Cordgrass/NL Cattail/Threesquare marsh [0.69]
* 6 = Open water [N/A]
7 = Red cedar/Switchgrass/Poison ivy [0.33]
8 = Open sand/Switchgrass [0.82]
* 9 = Iva/Phragmites [0.25]

0 100 200 Feet

N W E S

Figure 4-2. Vegetation and land cover of site TWS17. Features were drawn in the field directly onto recent low-altitude, black and white, digitally rectified aerial photographs (USACE 1998). Wetlands vegetation and land cover types are indicated by an asterisk (*) in the legend.

saline areas are dominated by salt water cordgrass (*Spartina alterniflora)* and salt hay (*Spartina patens*).

In general, the suite of vegetation on the fill site proper is of very low diversity compared with areas immediately to the north. These freshwater wetlands immediately adjacent to the site are notable, both in their vegetative diversity and in the fact that they are relatively unditched. Further, the area of these three related sites (TWS15, TWS17, TWS18) is drained by several apparently natural (i.e., not dredged or otherwise altered by mosquito commission activities) tidal creeks. The unditched nature of the marshes likely indicates that they possess a fairly natural tidal wetlands hydrology. This situation is contrasted with the heavily ditched tidal marshes to the south of these sites along Westecunk Creek, where the marshes are far less diverse.

4.2.3 Water Quality

Surface water quality was measured in one location on the small, unnamed tidal creek to the west of the site, as well as in several locations on Westecunk Creek and on the small unnamed adjacent tidal creeks during the field studies (refer to Section 1 for a description of the equipment used); Table 4-2 presents results. None of the parameters measured were atypical of local waterways in the general vicinity of the study area.

Table 4-2. Results of water quality testing done at Site TWS17 for the Barnegat Environmental Testing field studies.

Sampling Location	pH	Salinity (o/oo)	D.O. (mg/L)	Specific Conductivity (mS/cm)	Temp (°C)	Turbidity (NTU)
W1 (tidal creek to immediate west of site)	6.56	2.40	4.81	4.436	19.95	40.1

4.2.4 Wildlife

Wildlife and their signs (tracks, scats, calls, and other identifiable physical evidence) observed at the site while conducting the field studies included raccoon (*Procyon lotor*), white-tailed deer (*Odocoileus virginianus*), muskrat (*Ondatra zibethicus*), seaside sparrow (*Ammospiza maritima*), and marsh wren (*Cistothorus palustris*). It should also be noted that several current dens were also observed in the non-phragmites marsh to the north of the fill area. The muskrat dens were composed of the local vegetation, including threesquare and narrow-leaved cattails. Several areas of the marsh that were apparently grazed by muskrats were observed (threesquare was the primary species in these areas); "runs" created by the muskrats were also observed (these resembled small streams, and connected to the small unnamed tidal creek to the north). Many raccoon scats were observed, particularly in the vicinity of the small tidal creek to the west of the site (it was noted that the scats appeared to be composed entirely of crab shell). White-tailed deer tracks crossed many areas of the fill part of the site (no direct sightings were made,

however). Seaside sparrows and marsh wrens (most wren individuals observed were singing males) were observed along the small tidal creek to the north and east of the site. In addition, domestic dog tracks were also noted in many areas of the site, implying that they may frequent it.

In general, none of these three related habitats appear to be valuable to wildlife. The open, sandy habitats appear to be frequented by domestic dogs. The small red cedar trees along the edges of the site are widely-spaced and do not provide the same quality of habitat for nesting birds as a forest. The phragmites marsh encircling the site is dense, and does not appear to be used by wildlife, other than for temporary cover. Conversely, the relatively undisturbed, unditched marsh in the northern part of the site provides life requisites (e.g., food, fresh water, cover, breeding opportunities, etc.) for mammals, birds, and invertebrates, and is of great value to wildlife.

4.2.5 Environmental Problems at the Site

Loss of Habitat from Dredging and Filling

The site includes a large area of fill material that has eliminated a valuable freshwater tidal marsh habitat. The fill at the site covers approximately 1.6 acres; this apparently corresponds to the area of historic tidal marsh that was directly lost owing to the fill placement at the site (fill area is 360 ft. X 192 ft. = 69,120 ft^2 = 1.6 acres). Based on the more diverse area adjacent to the site, the fill evidently covered and eliminated relatively undisturbed, ecologically important freshwater tidal marsh. The placement of the fill also resulted in several other important peripheral ecological problems; see below.

Dominance by Phragmites

Most of the area immediately surrounding the outer edges of the sandy fill at this site is covered by a dense monoculture of phragmites (total of 7.10 acres). It is presumed that while phragmites was always a minor part of the vegetative cover at all three of these related sites, the placement of fill here allowed the existing phragmites to colonize first along its (wet) edges and then expand outward throughout the marsh. The dense monoculture of phragmites has replaced the more ecologically valuable tidal marsh vegetation communities. It is apparent, but not certain, that phragmites is still colonizing the marsh to the northeast of the site (west of site TWS15), where a mixture of phragmites and threesquare marsh is present.

4.2.6 Restoration Constraints and Other Site Information

Virtually all of the land on the north side of Westecunk Creek in the vicinity of the sites is freshwater tidal marsh; on the south side of the Creek is Westecunk Creek Dock Road and residences. Residences exist within about 150 to 200 feet of all three of the related sites. Because of the close proximity of these houses, spraying of herbicides for phragmites control will have to be coordinated with local residents. "Aquatic Pesticide Permits," issued by NJDEP, Pesticide Control Program would be required for all the large-scale herbicide applications in the Barnegat projects. The spray permits are typically issued under a pesticide license maintained by

the pilot or airport supplying the aircraft (personal communication, Eric Schrading, USFWS). In addition, the prescribed burning recommended at this site would also likely require a permit from the New Jersey Forest Fire Service.

No other potential restrictions have been identified to date for implementation of these projects. No submerged aquatic vegetation was observed in any areas of Westecunk Creek or in the small unnamed tidal creeks in the vicinity of the sites.

According to the USFWS draft Forsythe National Wildlife Refuge management plan (USFWS 2000), these sites are slated for restoration. At this time, therefore, we see no obvious conflicts with other potential management plans for these sites.

4.2.7 Restoration Concept

The restoration action at TWS17 includes (1) removal of the approximately 11,520 cubic yards of sandy dredged fill materials from the site and (2) eradication of phragmites. The fill removal would directly restore 1.6 acres of freshwater tidal marsh by re-establishment of the proper hydrologic regime and substrate to the marsh. Phragmites eradication would restore 14.13 acres of native marsh vegetation at the site, and would best be accomplished by aerial spraying of an herbicide agent containing glyphosate that is EPA-registered for use in aquatic and semi-aquatic environments. It is assumed that the marsh restoration would encourage re-growth of a suite of vegetation similar to that in the adjacent "unaffected marsh" (cordgrasses, bulrushes, swamp rose mallow, etc.; refer to Vegetation and Land Cover section, above). Success at similar tidal restoration sites was recently described in Zedler (2000), where vegetation successfully colonized with little or no planting, from adjacent wetlands and the tide. The project would foster ecosystem diversity by replacing a relatively monotypic system (phragmites) that likely possesses little overall value to area wildlife with a diverse freshwater wetland system that is increasingly rare in the study area.

4.2.8 Project Implementation

The project would be implemented in the fall and winter of the year (refer to next paragraph on phragmites removal). The approximately 11,520 cubic yards of sandy materials could be removed from the site using a small bulldozer, backhoe, or similar piece of equipment. The equipment would likely have to be brought in by barge or similar craft to the site at its southwestern-most end, where the fill extends to about 50 feet north of Westecunk Creek (the southeastern terminus of the fill is slightly farther to the north than the southwestern end). The equipment could be brought in over bog mats or similar structures to help protect this part of the phragmites marsh from excessive compaction. Access to the site by equipment must be limited to one point to minimize impacts to the existing phragmites marsh. Once the equipment has accessed the site, the small amount of woody vegetation (primarily small red cedar trees) could be easily removed and barged/boated away for disposal (these stumps, brush, and other materials could potentially be used as amenities for wildlife at other sites). The clean material would then be excavated to the original marsh surface (approximately 4.5 vertical feet of materials). The excavating work would be performed from north to south. This would allow the work to be

performed with no machinery moving back and forth over the original marsh surface, preventing additional compaction of the substrate.

Immediately after the fill materials have been excavated from the site, the phragmites eradication would take place. For the best effect of the glyphosate herbicide (such as Rodeo®), spraying of the phragmites would take place from early to mid-September. This is because the herbicide is achieved when transport of the photosynthesized sugars from the leaves of the plants to its rhizomes is maximized, reportedly during this time of year. Because of the open nature of the site, spraying could be accomplished either by fixed-wing craft or by helicopter (costs may be significantly lower by fixed-wing craft). For best success of removal, all 14.13 acres of phragmites at the three related sites would be sprayed at one time (or on successive days). Proper care must be taken to closely follow all manufacturer application and safety guidelines, particularly regarding appropriate wind and climatological conditions. The dead phragmites stands would then be control-burned in the winter to remove dead standing canes (winter burning maximizes the number of dead phragmites canes), and to enhance the success of follow-up herbicide treatments. It is recommended that follow-up aerial herbicide and burning treatments be made with the same timing (i.e, early fall herbicide treatment and winter burning) over at least three successive years. In addition, site inspections must be made beginning in late spring after the first aerial application to monitor the success of the phragmites eradication. Problem areas after several treatments must be noted; these (smaller) areas would be hand-sprayed with backpack sprayers or similar devices.

Monitoring and maintenance of the sites will involve a semi-annual inspection over at least three consecutive years to monitor re-growth (if any) of phragmites at the sites. Remaining phragmites stands would be mapped at this time, so that successive aerial or hand applications of herbicide can be reapplied.

4.2.9 Potential Environmental Impacts

It is estimated that environmental impacts resulting from implementation of the three related projects will be primarily restricted to loss of a very small amount of non-phragmites marsh vegetation on the peripheries of the sprayed areas. Herbicides containing glyphosate are non-selective, and will slowly kill virtually all vegetation that they contact. Such losses will be minimized with the selection and use of the most appropriate spray equipment (e.g., spray nozzles, booms, etc.) and their use during optimal atmospheric conditions. Applied correctly in the appropriate concentrations, the herbicide is not anticipated to cause any negative effects to existing invertebrates, fish, and wildlife currently using the sites.

Additional temporary impacts to the existing phragmites marsh on the southern end of the site may occur as the earth moving equipment is deployed on the site. These effects, however, will be minimized with the use of appropriate protective devices (e.g., bog mats). Appropriate use of erosion and sediment control measures (e.g., silt fences, temporary berms, biologs, etc.) would minimize sedimentation impacts to the adjacent tidal marsh and other sensitive areas during the construction work.

Implementation of the project would not likely result in any additional significant positive or negative impacts relating to air quality and noise levels, water quality, wetlands and other special aquatic areas, finfish, including Essential Fish Habitat, wildlife resources including, but not limited to, the target species that have been identified, and threatened and endangered species.

4.2.10 Estimated Costs

The following estimated costs include all elements of the project implementation at site TWS17, as stated above. The costs listed are approximate only, subject to change, and are primarily intended to indicate the relative magnitude of the project. Note that where a range of costs for each item was available, the maximum cost was used. It must also be noted that the clean, sandy materials removed from these three related sites could potentially be used as raw material for restoration actions at one or more of the other selected Barnegat sites (for example, this material could be deposited at ISS03 for creating beach-nesting bird habitats), thus defraying costs.

Sandy material excavation/transportation/spreading/disposal:
11,520 cubic yards @ $35.00 per c.y. = $403,200

Phragmites eradication:
Aerial herbicide: 7.10 acres @ $79.00 per acre = $561.00 X 3 treatments = $1,683.00
Controlled burns: $800.00 X 3 visits = $2,400.00

Materials:
Bog mat = $1,000.00

Monitoring and maintenance:
Phragmites mapping/backpack spraying: $800.00 X 6 visits = $4,800.00

GRAND TOTAL = $412,024

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4.3 SITE TWS18 (NORTH WESTECUNK CREEK)

4.3.1 Site Description and Ownership

Site TWS18 is owned by the USFWS and is included within the Edwin B. Forsythe refuge system. It is located approximately 1 mile south of West Creek, New Jersey, on the north side of Westecunk Creek, and is partially visible from West Creek Dock Road. As with sites TWS15 and TWS17, the fill area is roughly rectangular, oriented in an essentially northwest-southeast direction, and is a total of approximately 1.8 acres. The site consists of two main parts. The western section is an area of old, coarse sandy material that was apparently side-cast during adjacent dredging operations on Westecunk Creek. The eastern section is part of an old apparent industrial crabbing operation (some remnants of the operation, such as engines, boards, cables, etc., remain on the site; none of the materials appear hazardous) and possesses much less fill than the western part. Site TWS15 is located directly to the west of the site, across the small, unnamed tidal creek; site TWS17 is located directly to the west of site TWS15, across another small, unnamed tidal creek.

Substrate corings taken on the western part of the site indicate that the fill is an average of about 2.5 feet deep throughout, with a maximum depth of approximately 3 feet (taken from a direct measurement) and it consists entirely of coarse to medium sand (refer to Appendix B, field data sheets). Depth to groundwater at the western coring locations was an average of about 2.1 feet from the surface. Substrate corings taken in the eastern part of the site indicate the fill is an average of about 6 inches throughout. Depth to groundwater at the coring locations was an average of about 8 inches from the surface in the eastern part of the site. Based on an average fill depth of 2.5 feet and a measured fill area of 56,260 square feet (485 feet X 116 feet), a total of approximately 5,209 cubic yards (140,650 cubic feet) of sandy material exist on the western half of the site. Based on an average fill depth of 6 inches and a measured fill area of 23,718 square feet (201 feet X 118 feet), a total of approximately 439 cubic yards (11,859 cubic feet) of sandy material exist on the eastern half of the site. Combined, the western and eastern sections of the sites contain approximately 5,648 cubic yards of coarse to medium sandy materials.

TWS18A. Detail view taken during field studies to determine the depth of the fill at TWS18. The depth to groundwater at this location was just over 2 feet. Note the coarse, sandy nature of the fill material.

TWS18B. View looking northeast through the freshwater tidal marsh that borders the south-eastern end of the fill area of TWS18. Vegetation in the foreground is a mixture dominated by high tide bush and phragmites (weak); the mid-ground vegetation is a mixture of *Spartina patens*, *Spartina alterniflora*, and *Distichlis spicata*.

TWS18C. View of fill area in the southeastern part of the site. Immediately beyond the cedar trees is the unnamed tidal creek that forms the eastern boundary of the site. Note the weak phragmites present on this area of the fill (relatively shallow in this part of the site).

4.3.2 Vegetation and Land Cover

The site is bordered to the east and the west by a small, shallow, unnamed natural tidal creek, and to the south by Westecunk Creek. The majority of vegetation and land cover at the site consists of an open sand and shrubby edge community with small red cedar (*Juniperus virginiana*) and red maple (*Acer rubrum*) trees, and an understory of poison ivy (*Toxicodendron radicans*), switchgrass (*Panicum virgatum*), bromegrass (*Bromus tectorum*), and phragmites (*Phragmites australis*) (areas 5 and 6; Figure 4-3). It should be noted that the upland shrubby community on this site is proportionally larger than the open sand on this site. Beyond the shrubby edge is a monotypic, dense stand of phragmites (*Phragmites australis*) on all sides of the site, with several exceptions (area 1; Figure 4-3). To the Northeast, one finger of a larger area of salt hay (*Spartina patens*) and marsh spike grass (*Distichlis spicata*) extends to the site. In addition, a narrow area of big cordgrass (*Spartina cynosuroides*), high tide bush (*Iva frutescens*), and phragmites extends along the small tidal creek to the northeast of the fill. Beyond the large area of monotypic dense phragmites, this site is bordered to the north by a very large area of salt hay (*Spartina patens*) and marsh spike grass (*Distichlis spicata*). This large marsh area is bordered by narrow margins of big cordgrass and high tide bush along the small tidal creek, and also contains several pockets with narrow-leaved cattail (*Typha angustifolia*) and threesquare (*Scirpus pungens*).

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Figure 4-3. Vegetation and land cover of site TWS18. Features were drawn in the field directly onto recent low-altitude, black and white, digitally rectified aerial photographs (USACE 1998). Wetlands vegetation and land cover types are indicated by an asterisk (*) in the legend.

In general, the suite of vegetation on the fill site proper is of very low diversity compared with areas immediately to the north. These freshwater wetlands immediately adjacent to the site are notable, both in their vegetative diversity and in the fact that they are relatively unditched. Further, the area of these three related sites is drained by several apparently natural (i.e., not dredged or otherwise altered by mosquito commission activities) tidal creeks. The unditched nature of the marshes likely indicates that they possess a fairly natural tidal wetlands hydrology. This situation is contrasted with the heavily ditched tidal marshes to the south of these sites along Westecunk Creek where the marshes are far less diverse.

4.3.3 Water Quality

Surface water quality was measured in two locations on the small, unnamed tidal creek to the east of the site, as well as in one location on Westecunk Creek during the field studies (refer to Section 1 for a description of the equipment used); Table 4-3 presents results (see also Tables 4-1 and 4-2). None of the parameters measured were atypical of local waterways in the general vicinity of the study area.

Table 4-3. Results of water quality testing done at Site TWS18 for the Barnegat Environmental Testing field studies.

Sampling Location	pH	Salinity (o/oo)	D.O. (mg/L)	Specific Conductivity (mS/cm)	Temp (°C)	Turbidity (NTU)
W1 (West Creek, to NW of site; 5 ft.)	7.01	13.9	4.63	22.58	20.42	31.1
W2 (Tidal creek to east of site; 3.1 ft.)	7.09	5.61	3.96	9.959	19.07	23.7

4.3.4 Wildlife

Wildlife and their signs (tracks, scats, calls, and other identifiable physical evidence) observed at the site while conducting the field studies included raccoon (*Procyon lotor*), white-tailed deer (*Odocoileus virginianus*), seaside sparrow (*Ammospiza maritima*), and marsh wren (*Cistothorus palustris*). Many raccoon scats were observed, particularly in the vicinity of the small tidal creek to the east of the site (it was noted that the scats appeared to be composed entirely of crab shell). White-tailed deer tracks crossed many areas of the fill part of the site (no direct sightings were made, however). Seaside sparrows and marsh wrens (most wren individuals observed were singing males) were observed along the small tidal creeks bordering the east and west of the site.

In general, none of these three related habitats appear to be valuable to wildlife. The open, sandy habitats appeared to be frequented by domestic dogs. The small red cedar trees along the edges of the site are widely-spaced and do not provide the same quality of habitat for nesting birds as a forest. The phragmites marsh encircling the site is dense, and does not appear

to be used by wildlife, other than for temporary cover. Conversely, the relatively undisturbed, unditched marsh in the northern part of the site provides life requisites (e.g., food, fresh water, cover, breeding opportunities, etc.) for mammals, birds, and invertebrates, and is of great value to wildlife.

4.3.5 Environmental Problems at the Site

Loss of Habitat from Dredging and Filling

The site includes a large area of fill material that has eliminated a valuable freshwater tidal marsh habitat. The fill at the site covers approximately 1.8 acres; this apparently corresponds to the area of historic tidal marsh that was directly lost owing to the fill placement at the site (entire west and east fill areas are 686 ft. X 116 ft. = 79,576 ft^2 = 1.8 acres). Based on the more diverse vegetation species composition adjacent to the site, the fill evidently covered and eliminated relatively undisturbed, ecologically important freshwater tidal marsh. The placement of the fill also resulted in several other important peripheral ecological problems, such as invasion by phragmites.

Dominance by Phragmites

Most of the area immediately surrounding the outer edges of the sandy fill at this site is covered by a dense monoculture of phragmites (total of 4.4 acres). It is presumed that while phragmites was always a minor part of the vegetative cover at all three of these related sites, the placement of fill here allowed the existing phragmites to colonize first along its (wet) edges and expand outward throughout the marsh. The dense monoculture of phragmites has replaced the more ecologically valuable tidal marsh vegetation communities. It is apparent, but not certain, that phragmites is still colonizing the marsh to the north and northeast of the site, where a large area of salt hay and marsh spike grass is present.

4.3.6 Restoration Constraints and Other Site Information

Virtually all of the land on the north side of Westecunk Creek in the vicinity of the sites is freshwater tidal marsh; on the south side of the Creek is Westecunk Creek Dock Road and residences. Residences exist within about 150 to 200 feet of all three of the related sites. Because of the close proximity of these houses, spraying of herbicides for phragmites control will have to be coordinated with local residents. "Aquatic Pesticide Permits," issued by NJDEP, Pesticide Control Program would be required for all the large-scale herbicide applications in the Barnegat projects. The spray permits are typically issued under a pesticide license maintained by the pilot or airport supplying the aircraft (personal communication, Eric Schrading, USFWS). In addition, the prescribed burning recommended at this site would also likely require a permit from New Jersey Forest Fire Service.

No other potential restrictions have been identified to date for implementation of these projects. No submerged aquatic vegetation was observed in any areas of Westecunk Creek or in the small, unnamed tidal creeks in the vicinity of the sites during the field studies.

According to the USFWS draft Forsythe National Wildlife Refuge management plan (USFWS 2000), these sites are slated for restoration. At this time, therefore, we see no obvious conflicts with other potential management plans for these sites.

4.3.7 Restoration Concept

The restoration action at TWS18 includes (1) removal of all the approximately 5,648 cubic yards of sandy dredged fill materials from the site and (2) eradication of phragmites. The fill removal would directly restore 1.8 acres of freshwater tidal marsh by re-establishment of the proper hydrologic regime and substrate to the marsh. Phragmites eradication would restore 4.40 acres of native marsh vegetation at the site, and would best be accomplished by aerial spraying of an herbicide agent containing glyphosate that is EPA-registered for use in aquatic and semi-aquatic environments. It is assumed that the marsh restoration would encourage re-growth of a suite of vegetation similar to that in the adjacent "unaffected marsh" (cordgrasses, bulrushes, swamp rose mallow, etc.; refer to Vegetation and Land Cover section, above). Success at similar tidal restoration sites was recently described in Zedler (2000), where vegetation successfully colonized with little or no planting, from adjacent wetlands and the tide. The project would foster ecosystem diversity by replacing a relatively monotypic system (phragmites) that likely possesses little overall value to area wildlife with a diverse freshwater wetland system that is increasingly rare in the study area.

4.3.8 Project Implementation

The project would be implemented in the early fall and winter of the year (refer to next paragraph on phragmites removal). The approximately 5,648 cubic yards of sandy materials could be removed from the site using a small bulldozer, backhoe, or similar piece of equipment. The equipment would likely have to be brought in by barge or similar craft to the site's southeastern-most end, where the fill extends all the way to the bank of Westecunk Creek. The equipment could be brought in over bog mats or similar structures to help protect the banks of the creek from excessive compaction. Access to the site by equipment must be limited to one point to minimize impacts. Once the equipment has accessed the site, the small amount of woody vegetation (primarily small red cedar trees) could be easily removed and barged/boated away for disposal (these stumps, brush, and other materials could potentially be used as amenities for wildlife at other sites). The clean material would then be excavated to the original marsh surface (approximately 3 vertical feet of materials in the western part and 6 inches in the eastern part). The excavating work would be performed from west to east.

Immediately after the fill materials have been excavated from the site, the phragmites eradication would take place. For the best effect of the glyphosate herbicide, spraying of the phragmites would take place from beginning to mid-September. This is because the herbicide is most effective when transport of the photosynthesized sugars from the leaves of the plants to its rhizomes is maximized, reportedly during this time of year. Because of the open nature of the site, spraying could be accomplished either by fixed-wing craft or by helicopter (costs may be significantly lower by fixed-wing craft). For best success of removal, all 14 acres of phragmites at the three related sites would be sprayed at one time (or on successive days). Proper care must

be taken to closely follow all manufacturer application and safety guidelines, particularly regarding appropriate wind and climatological conditions. The dead phragmites stands would then be control-burned in the winter to remove dead standing canes (winter burning maximizes the number of dead phragmites canes), and to enhance the success of follow-up herbicide treatments. It is recommended that follow-up aerial herbicide and burning treatments be made with the same timing (i.e., early fall herbicide treatment and winter burning) over at least three successive years. In addition, site inspections must be made beginning in late spring after the first aerial application to monitor the success of the phragmites eradication. Problem areas after several treatments must be noted; these (smaller) areas would be hand-sprayed with backpack sprayers or similar devices.

Monitoring and maintenance of the sites will involve a semi-annual inspection over at least three consecutive years to monitor re-growth (if any) of phragmites at the sites. Remaining phragmites stands would be mapped at this time, for use in either successive aerial or hand applications of herbicide.

4.3.9 Potential Environmental Impacts

It is estimated that environmental impacts resulting from implementation of the three related projects will be primarily restricted to loss of a very small amount of non-phragmites marsh vegetation on the peripheries of the sprayed areas. Herbicides containing glyphosate are non-selective, and will slowly kill virtually all vegetation that they contact. Such losses will be minimized with the selection and use of the most appropriate spray equipment (e.g., spray nozzles, booms, etc.) and their use during optimal atmospheric conditions. Applied correctly in the appropriate concentrations, the herbicide is not anticipated to cause any negative effects to existing invertebrates, fish, and wildlife currently using the sites.

Additional temporary impacts to the existing phragmites marsh on the southern end of the site may occur during movement of earth moving equipment onto the site. These effects, however, will be minimized with the use of appropriate protective devices (e.g., bog mats). Appropriate use of erosion and sediment control measures (e.g., silt fences, temporary berms, biologs, etc.) would minimize sedimentation impacts to the adjacent tidal marsh and other sensitive areas during the construction work.

Implementation of the project would not likely result in any additional significant positive or negative impacts relating to air quality and noise levels, water quality, wetlands and other special aquatic areas, finfish, including Essential Fish Habitat, wildlife resources including, but not limited to, the target species that have been identified, and threatened and endangered species.

4.3.10 Estimated Costs

The following approximate estimated costs include all elements of the project implementation at site TWS18, as stated above. The costs listed are approximate only, subject to change, and are primarily intended to indicate the relative magnitude of the project. Note that where a

range of costs for each item was available, the maximum cost was used. It must also be noted that the clean, sandy materials removed from these three related sites could potentially be used as raw material for restoration actions at one or more of the other selected Barnegat sites (for example, this material could be deposited at ISS03 for creating beach-nesting bird habitats), thus defraying costs.

Sandy material disposal/transportation/spreading:
5,648 cubic yards @ $35.00 per c.y. = $197,680

Phragmites eradication:
Aerial herbicide: 4.40 acres @ $79.00 per acre = $348.00 X 3 treatments = $1,044.00
Controlled burns: $800.00 X 3 visits = $2,400.00

Materials:
Bog mat = $1,000.00

Monitoring and maintenance:
Phragmites mapping/backpack spraying: $800.00 X 6 visits = $4,800.00

GRAND TOTAL = $206,924

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4.4 SITE TWS23 (SOUTH WESTECUNK CREEK)

4.4.1 Site Description and Ownership

Site TWS23 is owned by the USFWS and is included within the Edwin B. Forsythe refuge system. It is located approximately 2 miles south of West Creek, New Jersey, on the north side of Westecunk Creek at its mouth, and is partially visible from near the terminus of West Creek Dock Road (as essentially the only trees on the marsh landscape). The fill area is nearly circular in shape (slightly longer east to west than north to south), and approximately 30 acres. The site has been used for the disposal of dredged material within the past 20 years; no berms or dikes were apparent on the site. It is generally highest in elevation near its southwestern end, and appeared to be lowest in elevation in the northeastern section. The southern three Westecunk Creek sites (particularly TWS23) are generally more isolated from the residences along West Creek Dock Road than the three northern sites.

Substrate corings taken throughout the site and other measurements indicate that the fill in the highest part of the site (where a small area of scrubby deciduous trees exists) is an average of about 3 to 5 feet above the undisturbed marsh adjacent to Westecunk Creek; this high spot consists almost entirely of oyster shells. A slightly lower area (i.e., possesses less fill material) partially encircles the high point, and is approximately 2 to 3 feet above the undisturbed marsh adjacent to Westecunk Creek; the fill here consists of medium sand. The rest of the site is approximately 1.5 to 2 feet above the undisturbed marsh adjacent to Westecunk Creek; the fill here consists of fine silt (refer to Appendix B, field data sheets). Groundwater was not intercepted during coring at the highest two levels of the site, but was at or near the surface in the lowest areas (i.e., throughout area 1.5 to 2 feet above existing marsh). Because of the extreme difficulty of traversing this site (the majority of it possesses a very dense cover of phragmites) and its large size, the fill area dimensions (with the exception of depth) were not measured in the field.

TWS23A. View of the TWS23 site looking north from the left bank of Westecunk Creek. Note the dense, monotypic growth of phragmites in this part of the site.

TWS23B. View looking west from a tree on the high point (area 4, Figure 4-4) of TWS23. Note the dense phragmites from this point to Westecunk Creek.

TWS23C. Detail view of the oyster shells that comprise the high point (area 4, Figure 4-4) of TWS23. The fill material in this location consists of oyster shells to a depth of at least 4 feet.

4.4.2 Vegetation and Land Cover

The primary vegetation type at site TWS23 is phragmites marsh; in virtually all areas, the marsh is dominated by phragmites (*Phragmites australis*) in very tall, dense, monotypic stands (area 2, Figure 4-4). A U-shaped stand of monotypic phragmites on uplands also exists in the south-central part of the site (area 3). Enclosed inside the U-shaped phragmites stand is a small area of very sparse deciduous forest (area 4). The upland forest contains a mixture of small red cedar (*Juniperus virginiana*), white mulberry (*Morus alba*), and red maple (*Acer rubrum*) trees (generally less than 5 inches diameter at breast height, dbh), with a dense understory of poison ivy (*Toxicodendron radicans*), Japanese honeysuckle (*Lonicera japonica*), and phragmites. Along the northeastern boundary of the site is a narrow band containing an approximately even mixture of phragmites and high tide bush (*Iva frutescens*); two other small areas of this vegetation type occur in the southern part of the site (areas 6). One very narrow area of tidal marsh was mapped along the southern boundary of the site (area 1). The tidal marsh is dominated by salt water cordgrass (*Spartina alterniflora*), interspersed with smaller quantities of salt hay (*Spartina patens*), and high tide bush along its northern margin. Three small separate areas in the northeastern part of the site possess dense stands of marsh spike grass (*Distichlis spicata*) and salt hay. These three areas appear to possess a slightly wetter hydrologic regime than the surrounding phragmites marsh.

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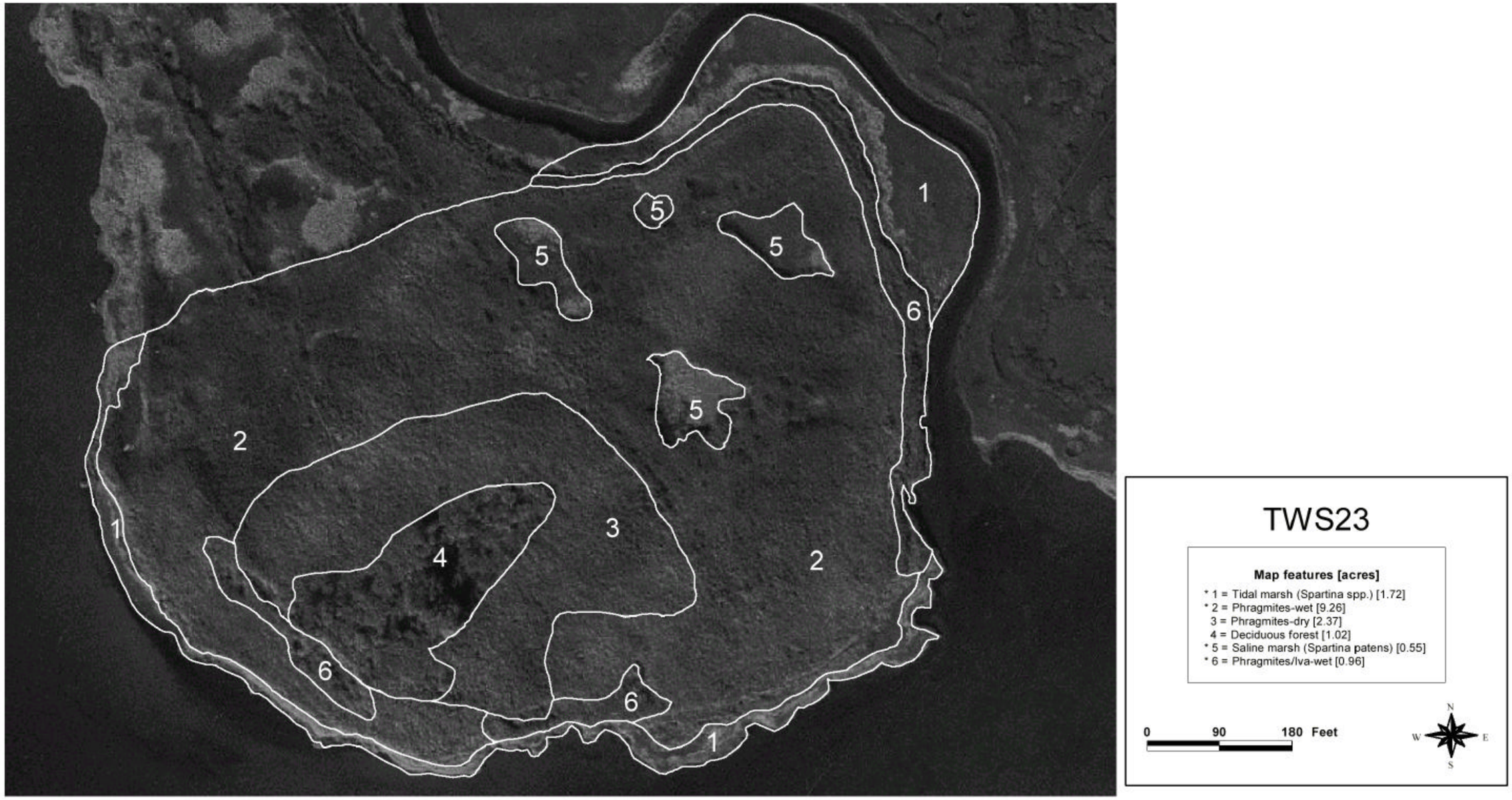

Figure 4-4. Vegetation and land cover of site TWS23. Features were drawn in the field directly onto recent low-altitude, black and white, digitally rectified aerial photographs (USACE 1998). Wetlands vegetation and land cover types are indicated by an asterisk (*) in the legend.

The site is bordered to the northeast and northwest by large areas of tidal marsh, dominated by salt water cordgrass, salt hay, marsh spike grass, and high tide bush, with shallow isolated tidal pools and tidal creeks.

In general, the suite of vegetation on the site is of low diversity compared with the off-site tidal marsh immediately to the northeast and northwest. The off-site tidal marshes are heavily grid-ditched (as part of former mosquito control efforts in the region), but appear to be of relatively high value and contain little phragmites.

4.4.3 Water Quality

Surface water quality was not measured at site TWS23 because no surface water features exist at the site, and because extensive tests were done throughout Westecunk Creek and its unnamed tidal tributaries as part of the studies for the northern three Westecunk Creek sites and for TWS24 (refer to individual site descriptions and data sheets, Appendix B).

4.4.4 Wildlife

Wildlife and their signs (tracks, scats, calls, and other identifiable physical evidence) observed at the site while conducting the field studies were all birds, including fish crow (*Corvus ossifragus*), greater black-backed gull (*Larus marinus*), herring gull (*Larus argentatus*), yellow warbler (*Dendroica petechia*), and common yellowthroat (*Geothlypis trichas*). In addition, several marsh wrens (*Cistothorus palustris*) were observed off the site to the north in the tidal marsh adjacent to the unnamed tidal creek above the site. All of the birds were observed along the southern outer edges of the site, adjacent to the tidal marsh, not in its interior. It was noted that the current conditions on the site are not conducive for many species of wildlife; relatively undisturbed, valuable habitats exist only in the tidal marshes immediately off the site. The several upland areas containing sparse deciduous trees and shrubs are currently very small, but may support a small number of migratory songbirds (although none were observed in several visits to the site during the breeding season). The dense phragmites stands that exist on-site provide little food, cover, or breeding habitats for most species of native wildlife, and are consequently considered of low value to wildlife.

4.4.5 Environmental Problems at the Site

<u>Loss of Habitat from Dredging and Filling</u>

The dredged materials fill at the site covers virtually its entire 30 acres; the fill was presumably placed directly over the original tidal marsh. The depth of the fill varies, but is of the greatest depth in the south-central parts of the site (corresponding to areas 3 and 4, Figure 4-4). The fill in the central part of this area (area 4, Figure 4-4) is composed solely of 3 to 5 feet of oyster shells; both areas are uplands. The remainder of the site possesses a relatively thin layer of fine silt fill (presumably over the original tidal marsh), and is wetland (albeit very degraded). The smallest amounts of fill (i.e., the thinnest layers) exist in the northeastern part of the site (some small areas appear to possess 1 vertical foot or less of fill). The only area

apparently possessing no fill is the narrow margin of tidal marsh along the southern boundary of the site.

Dominance by Phragmites

The majority of site TWS23 is dominated by a dense monotypic cover of phragmites. The thin layer of fill in most areas prevents regular tidal exposure or inundation of the phragmites by the saline conditions of Westecunk Creek (on the order of 24 parts per thousand, resembling sea water). It is apparent from the dense, tall condition of the phragmites that these on-site marshes are freshwater (probably groundwater or precipitation-fed), and are never exposed to the tide from the creeks. Because the tidal marshes directly off the site are exposed to the (saline) tide, it is unlikely that phragmites will expand from the site onto these areas. It has been demonstrated that phragmites can be easily and thoroughly killed when exposed to regular tidal flooding by waters with a salinity of at least 18 parts per thousand (Barrett and Niering 1993).

4.4.6 Restoration Constraints and Other Site Information

All of the land on the north side of Westecunk Creek in the vicinity of the southern sites is tidal marsh (the marsh here is apparently not freshwater as in the northern three sites, as evidenced by the *Spartina*-dominated plant community and the water chemistry results); on the south side of the Creek is Westecunk Creek Dock Road and residences. A few residences exist within about 400 to 500 feet to the southwest of the site; a large area of tidal marsh is located on the south bank of the creek to the southeast (because TWS23 is close to its mouth, the creek is very wide in this location). "Aquatic Pesticide Permits," issued by NJDEP, Pesticide Control Program would be required for all the large-scale herbicide applications in the Barnegat projects. The spray permits are typically issued under a pesticide license maintained by the pilot or airport supplying the aircraft (personal communication, Eric Schrading, USFWS). No submerged aquatic vegetation was observed in any areas of Westecunk Creek or in the small, unnamed tidal creeks in the vicinity of the sites during the field studies. In addition, the prescribed burning recommended at this site would also likely require a permit from the New Jersey Forest Fire Service.

It must be noted that in recent meetings between the NJDEP Division of Engineering & Construction and USACE Operations (see minutes from 13 July and 20 July 2000, Appendix A), concerns were voiced that there may be a need for future dredged materials disposal on some parts of TWS23. Such materials disposal need not necessarily completely preclude restoration actions at the site, however, particularly if the restoration actions call for creation and enhancement of upland habitats only. Upland restoration areas could be isolated from future disposal actions by addition of berms and proper planning.

According to the USFWS draft Forsythe National Wildlife Refuge management plan (USFWS 2000), these sites are slated for restoration. At this time, therefore, we see no obvious conflicts with other potential management plans for these sites.

4.4.7 Restoration Concept

It was observed that a number of potential restoration sites examined during the Barnegat Environmental Testing field studies possessed well-drained high points where dryness (and occasionally shading from trees) apparently prevented phragmites from colonizing (these consisted of both forested and non-forested habitats). Because of their apparent value to wildlife, expansion of such habitats is proposed as a restoration concept for TWS23. The restoration action at TWS23 would include addition of clean, sandy fill within the area of upland phragmites surrounding the existing thinly-vegetated upland forested area (areas 3 and 4, Figure 4-4). Raising the vertical elevation of the upland phragmites area approximately 2 vertical feet (bringing area 3 to approximately the same elevation as area 4) to a sufficient height with well to excessively-drained materials would preclude (or at least slow) future re-colonization of this area by phragmites; most importantly, it would provide suitable conditions for colonization by trees and shrubs, similar to those found on the high point of the site (i.e., area 4; see Vegetation and Land Cover). This action could convert approximately 2.37 acres of virtually unused upland habitat at the site to habitat valuable for native wildlife, including migratory songbirds, and mammals.

Prior to the addition of the fill within the upland phragmites area, the phragmites would be eradicated specifically within this parcel. It would also be prudent to eradicate at least an additional 100-foot buffer of phragmites along the outer edge of the upland phragmites (i.e., within area 2, wetland phragmites) to help prevent re-colonization within the restoration area. Phragmites eradication would best be accomplished by aerial spraying of an herbicide agent containing glyphosate that is EPA-registered for use in aquatic and semi-aquatic environments.

After phragmites eradication is successful and complete, the newly-created area would be planted with native trees and shrubs. While natural colonization of these species probably would occur over time, planting would greatly help to ensure success of forested habitat establishment (and prevent establishment of undesirable species).

4.4.8 Project Implementation

The project would be implemented in the early fall and winter of the year (refer to next paragraph on phragmites removal). Area 3 would require 7,647 cubic yards of materials to raise it to approximately the same elevation as area 4 (2.37 acres = 103,237 ft^2 X 2 vertical feet = 206,474 cubic feet = 7,647 cubic yards). The approximately 7,647 cubic yards of sandy materials could be added to the site using a small bulldozer, backhoe, or similar piece of equipment. The materials and equipment would likely have to be brought in by barge or similar craft to the site at its southwestern-most end, in the area where the existing high point (area 4) extends closest to the bank of Westecunk Creek. The equipment could be brought in over bog mats or similar structures to help protect the banks of the creek, the narrow band of tidal marsh, and phragmites marsh from excessive compaction. Access to the site by equipment must be limited to one point to minimize impacts. The materials deposition would be performed from north to south.

The phragmites eradication would take place prior to adding the fill materials to the site. For the best effect of the glyphosate herbicide, spraying of the phragmites would take place from beginning to mid-September. This is because the best effect of the herbicide is achieved when transport of the photosynthesized sugars from the leaves of the plants to its rhizomes is maximized, reportedly during this time of year (Harriott and Burton 1997). Because of the open nature of the site, spraying could be accomplished either by fixed-wing craft or by helicopter (costs may be significantly lower by fixed-wing craft). For best success of removal, all phragmites eradication would be performed at one time (or on successive days). Proper care must be taken to closely follow all manufacturer application and safety guidelines, particularly regarding appropriate wind and climatological conditions. The dead phragmites stands would then be control-burned in the winter to remove dead standing canes (winter burning maximizes the number of dead phragmites canes), and to enhance the success of follow-up herbicide treatments. It is recommended that follow-up aerial herbicide and burning treatments be made with the same timing (i.e, early fall herbicide treatment and winter burning) over at least three successive years. In addition, site inspections must be made beginning in late spring after the first aerial application to monitor the success of the phragmites eradication. Persistent problem areas after several treatments must be noted; these (smaller) areas would be hand-sprayed with backpack sprayers or similar devices.

After phragmites eradication is successful and complete, the newly-created area can be planted with native trees, shrubs, and herbaceous plants. These would include a mixture of the native species noted in upland habitats at several area sites, including bayberry (*Myrica pensylvanica*), groundsel bush (*Baccharis halimifolia*), black cherry (*Prunus serotina*), red maple (*Acer rubrum*), and beachgrass (*Ammophila breviligulata*). Assuming a minimal 250 plant-per-acre installation density, approximately 593 plants would be required for establishment of the 2.37-acre area.

Monitoring and maintenance of the sites will involve a semi-annual inspection over at least three consecutive years to monitor the created habitats for success of the plantings and phragmites eradication. An approximately 85 percent minimal survival rate of the plantings the third year after installation will be applied as a measure of success. Phragmites invasions onto the upland restored area would be mapped during the semi-annual inspections, for use in either successive aerial or hand applications of herbicide.

4.4.9 Potential Environmental Impacts

It is estimated that environmental impacts resulting from implementation of the three related projects will be primarily restricted to loss of a small amount of phragmites marsh vegetation (i.e., primarily phragmites) on the peripheries of the sprayed areas. Several small parcels dominated by phragmites but also containing high tide bush (areas 6) also border area 3 to the south. These small areas could be treated with herbicide by hand to minimize high tide bush mortality. Herbicides containing glyphosate are non-selective, and will slowly kill virtually all vegetation that they contact. Such losses will be minimized with the selection and use of the most appropriate spray equipment (e.g., spray nozzles, booms, etc.) and their use during optimal atmospheric conditions. Applied correctly in the appropriate concentrations, the herbicide is not

anticipated to cause any negative effects to existing invertebrates, fish, and wildlife currently using the sites.

Other temporary impacts to the existing tidal marsh and phragmites marsh on the southwestern end of the site may occur during movement of earth moving equipment onto the site. These effects, however, will be minimized with the use of appropriate protective devices (e.g., bog mats). Appropriate use of erosion and sediment control measures (e.g., silt fences, temporary berms, biologs, etc.) would minimize sedimentation impacts to the adjacent tidal marsh and other sensitive areas during the construction work.

Implementation of the project would not likely result in any additional significant positive or negative impacts relating to air quality and noise levels, water quality, wetlands and other special aquatic areas, finfish, including Essential Fish Habitat, wildlife resources including, but not limited to, the target species that have been identified, and threatened and endangered species.

4.4.10 Estimated Costs

The following approximate estimated costs relate to the principal elements of the project implementation at site TWS23, as stated above. The costs listed are approximate only, subject to change, and are primarily intended to provide perspective of the relative magnitude of the project. It must also be noted that where a range of costs for each item was available, the maximum cost was used. Note also that the clean, sandy materials removed from the three northern Westecunk Creek sites (TWS15, TWS17, and TWS18) could potentially be used as a nearby material source for restoration actions at TWS23, thus defraying costs.

Sandy material disposal/transportation/spreading:
7,647 cubic yards @ $35.00 per c.y. = $267,645

Phragmites eradication:
Aerial herbicide: 5 acres @ $79.00 per acre = $395.00 X 3 treatments = $1,185.00
Controlled burns: $800.00 X 3 visits = $2,400.00

Plant materials/installation/materials:
593 container seedling plants @ $3.00 each = $1,779.00
General labor 48 person-hours @ $35.00 per hour = $1,680.00
Bog mat = $1,000.00

Monitoring and maintenance:
Phragmites mapping/backpack spraying: $800.00 X 6 visits = $4,800.00

GRAND TOTAL = $280,489

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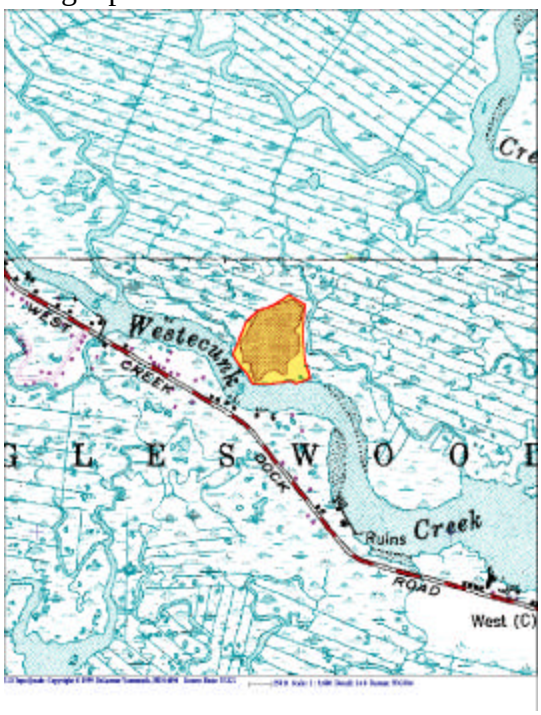
4.5 SITE TWS24 (SOUTH WESTECUNK CREEK)

4.5.1 Site Description and Ownership

Site TWS24 is owned by the USFWS and is included within the Edwin B. Forsythe refuge system. It is located approximately 1.8 miles south of West Creek, New Jersey, on the north side of Westecunk Creek at its mouth, and is partially visible from West Creek Dock Road (as essentially the only trees on this part of this marsh landscape). The site is roughly rectangular in shape (slightly longer north to south than east to west), and is a total of approximately 30 acres. The site has been used for the disposal of dredged material within the past 20 years; only one berm exists on the site, near the southern boundary. TWS24 is highest in elevation near its center (area 6, Figure 4-5). The site appeared to be lowest in elevation in the tidal marsh along Westecunk Creek (area 1) and in a large area of phragmites and salt marsh cord grass (area 3) in the northwestern section. The southern three Westecunk Creek sites are generally more isolated from the residences along West Creek Dock Road than the three northern sites.

Substrate corings taken throughout the site and other measurements indicate that the fill in the highest part of the site (area 6, where a small area of scrubby deciduous trees and open sand exists) is an average of about 8 feet above the undisturbed marsh adjacent to Westecunk Creek; the substrate on this high spot consists almost entirely of sandy silt. Two other upland areas exist that possess less fill material (areas 4). The first encircles the high point, and the second is in a separate parcel to the southeast of the high point. Both of these areas are approximately 5 feet above the undisturbed marsh adjacent to Westecunk Creek; the fill in both areas consists of sandy silt. One other slightly lower area of upland (area 7) connects the highest parts of the site; this large parcel varies from about 3 to 5 feet above the adjacent undisturbed marsh and the substrate is composed of a fine sandy silt. The remainder of the site is wet (areas 3 and 5), and is an average of only 1 to 2 feet above the adjacent undisturbed marsh; the fill here consists of fine silt (refer to Appendix B, field data sheets). Groundwater was not intercepted during coring at the highest two levels of the site, but was at or near the surface in the lowest areas (i.e., throughout area 1 to 2 feet above existing marsh). Because of the difficulty of traversing this site (a large part of it possesses a very dense cover of phragmites) and its large size, the fill area dimensions (with the exception of depth) were not measured in the field.



TWS24A. View looking southeast through the southern part of area 3 (Figure 4-5) at TWS24. Note the interspersion of phragmites with spartina in this part of the site. The trees in the upper left corner of the photo are within area 4 of the site.

TWS24B. View of the TWS24 site looking northwest through area 7. Note the dense, monotypic growth of phragmites in this part of the site.

TWS24C. View looking north at the unnamed tidal creek that forms part of the eastern boundary of site TWS24. Note the contrast between the dense phragmites on the site (left side of the photo) and the spartina marsh off the site (right side of the photo, across the creek).

4.5.2 Vegetation and Land Cover

The primary vegetation type at site TWS24 is phragmites marsh; in virtually all areas, the marsh is dominated by phragmites (*Phragmites australis*) in very tall, dense, monotypic stands (area 5, Figure 4-5). Another large wetland area (area 3) contains a mixture of phragmites (weak), salt water cordgrass (*Spartina alterniflora*), salt hay (*Spartina patens*), and marsh spike grass (*Distichlis spicata*). A large stand of phragmites with an occasional high tide bush along the outer edges (particularly along the eastern boundary) on uplands exists in a band extending from near the eastern side of the site to its southern boundary. Along the eastern and northwestern site boundaries are two narrow bands containing an approximately even mixture of phragmites and high tide bush (*Iva frutescens*) (area 2). In the northern-most and southwestern-most areas are narrow bands of relatively undisturbed tidal marsh (areas 1) dominated by salt water cordgrass; also present are salt hay and marsh spike grass.

The two highest points on site TWS24 (areas 4 and 6) are covered by a mixture of deciduous shrubs, trees, and grasses. Principal species in area 4 include bayberry (*Myrica pensylvanica*), groundsel bush (*Baccharis halimifolia*), poison ivy (*Toxicodendron radicans*), and phragmites (dense); scattered throughout are small sassafras (*Sassafras albidum*) and red maple (*Acer rubrum*) trees (generally less than 5 inches diameter at breast height, dbh). Downy brome (*Bromus tectorum*) is the principal species in area 6, but it also contains switchgrass (*Panicum virgatum*) and scattered small bayberry, and groundsel bush.

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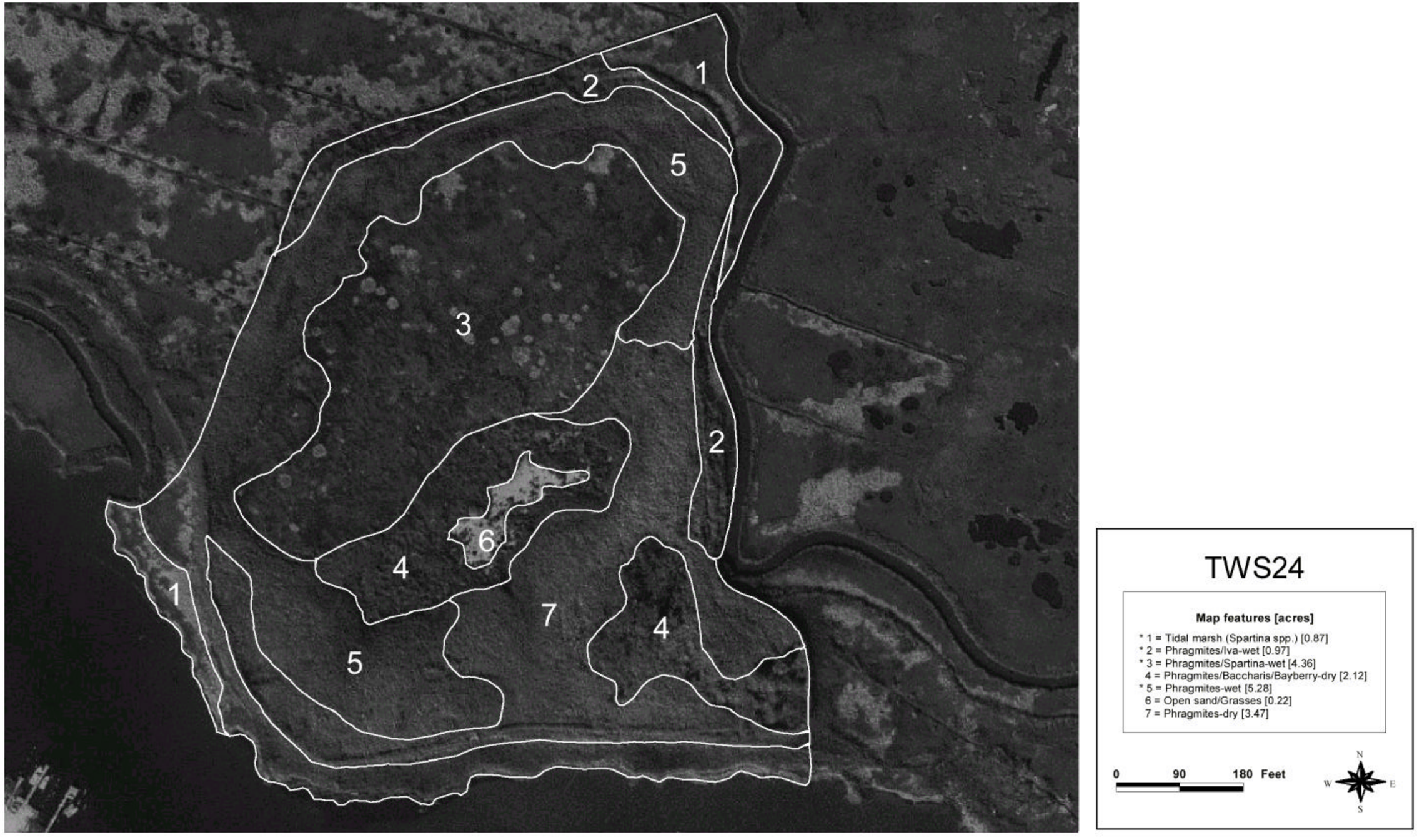


Figure 4-5. Vegetation and land cover of site TWS24. Features were drawn in the field directly onto recent low-altitude, black and white, digitally rectified aerial photographs (USACE 1998). Wetlands vegetation and land cover types are indicated by an asterisk (*) in the legend.

The site is bordered to the north, northeast, and northwest by large areas of tidal marsh, dominated by salt water cordgrass, salt hay, marsh spike grass, and high tide bush, with shallow isolated tidal pools and tidal creeks. Although these marshes were historically grid-ditched for mosquito control, they appear undisturbed on the ground, contain little phragmites, and undoubtedly comprise good habitats for wildlife.

4.5.3 Water Quality

Surface water quality was measured in three locations near site TWS24 on Westecunk Creek during the field studies (refer to Section 1 for a description of the equipment used); Table 4-4 presents results. None of the parameters measured were atypical of local waterways in the general vicinity of the study area. Note the apparent freshwater "lens" in the upper part of the creek at sampling point W2/W3.

Table 4-4. Results of water quality testing done in the vicinity of Site TWS24 for the Barnegat Environmental Testing field studies.

Sampling Location	pH	Salinity (o/oo)	D.O. (mg/L)	Specific Conductivity (mS/cm)	Temp (°C)	Turbidity (NTU)
W1 (West Creek at site; 0.155 m)	7.01	18.48	7.41	29.53	23.86	33.2
W2 (about 0.5 mile upstream from site; surface)	7.54	7.04	7.19	12.15	23.63	25.1
W3 (same loc. as W2; 1 m)	7.12	16.46	5.02	27.06	25.00	N/A

4.5.4 Wildlife

Wildlife and their signs (tracks, scats, calls, and other identifiable physical evidence) observed at the site while conducting the field studies were all birds, including herring gull (*Larus argentatus*), sharp-tailed sparrow (*Ammospiza caudacuta*), common yellowthroat (*Geothlypis trichas*), and marsh wren (*Cistothorus palustris*). All of the birds were observed along the southern outer edges of the site, adjacent to the tidal marsh, not in its interior. It was noted that the current conditions on the site are not conducive for many species of wildlife; relatively undisturbed, valuable habitats exist only in the tidal marshes immediately off the site. The several upland areas containing sparse deciduous trees and shrubs are very small, but may support a small number of migratory songbirds (although none were observed in several visits to the site during the breeding season). The dense phragmites stands that exist on-site provide little food, cover, or breeding habitats for most species of native wildlife, and are consequently considered of low value to wildlife.

4.5.5 Environmental Problems at the Site

Loss of Habitat from Dredging and Filling

The dredged materials fill at the site covers virtually its entire 30 acres; the fill was presumably placed directly over the original tidal marsh. The depth of the fill varies, but it is of the greatest depth in the central part of the site (corresponding to areas 6 and 4, Figure 4-5). The fill in the central part of this area (area 6) is composed of about 8 feet of fine sand and silt. Both areas of 4 possess about 5 feet of sandy silt. Fill in area 7 varies between 3 to 5 feet in depth. The remainder of the site possesses a relatively thin layer of fine silt fill (presumably over the original tidal marsh), and is wetland (albeit very degraded). The smallest amounts of fill (i.e., the thinnest layers) exist in the northeastern part of the site (some small areas appear to possess 1 vertical foot or less of fill). The only area apparently possessing no fill is the narrow margin of tidal marsh along the southern boundary of the site.

Dominance by Phragmites

A large part of site TWS24 is dominated by a dense monotypic cover of phragmites. The thin layer of fill in most areas prevents regular tidal exposure or inundation of the phragmites by the saline conditions of Westecunk Creek (on the order of 18 parts per thousand, approaching the salinity of sea water). It is apparent from the dense, tall condition of the phragmites that these on-site marshes are freshwater (probably groundwater or precipitation-fed), and are never exposed to the tide from the creeks. Because the tidal marshes directly off the site are exposed to the (saline) tide, it is unlikely that phragmites will expand from the site onto these areas. It has been demonstrated that phragmites can be easily and thoroughly killed when exposed to regular tidal flooding by waters with a salinity of at least 18 parts per thousand (Barrett and Niering 1993).

4.5.6 Restoration Constraints and Other Site Information

All of the land on the north side of Westecunk Creek in the vicinity of the southern sites is tidal marsh (the marsh here is apparently not freshwater as in the northern three sites, as evidenced by the *Spartina*-dominated plant community and the water chemistry results); on the south side of the Creek is Westecunk Creek Dock Road and residences. A few residences exist within about 400 to 500 feet to the southwest of the site; a large area of tidal marsh is located on the south bank of the creek to the southeast (because TWS24 is close to the mouth of the creek, it is very wide in this location). "Aquatic Pesticide Permits," issued by NJDEP, Pesticide Control Program would be required for all the large-scale herbicide applications in the Barnegat projects. The spray permits are typically issued under a pesticide license maintained by the pilot or airport supplying the aircraft (personal communication, Eric Schrading, USFWS). In addition, the prescribed burning recommended at this site would also likely require a permit from the New Jersey Forest Fire Service. No submerged aquatic vegetation was observed in any areas of Westecunk Creek or in the small, unnamed tidal creeks in the vicinity of the sites during the field studies.

It must be noted that in recent meetings between the NJDEP Division of Engineering & Construction and USACE Operations (see minutes from 13 July and 20 July 2000, Appendix A), concerns were voiced that there may be a need for future dredged materials disposal on some parts of TWS24. Such materials disposal need not necessarily completely preclude restoration actions at the site, however, particularly if the restoration actions call for creation and enhancement of upland habitats only. Upland restoration areas could be isolated from future disposal actions by addition of berms and proper planning.

According to the USFWS draft Forsythe National Wildlife Refuge management plan (USFWS 2000), these sites are slated for restoration. At this time, therefore, we see no obvious conflicts with other potential management plans for these sites.

4.5.7 Restoration Concept

It was observed that a number of potential restoration sites examined during the Barnegat Environmental Testing field studies possessed well-drained high points where dryness and shading from scrubby trees apparently prevented phragmites from colonizing (these consisted of both forested and non-forested habitats). Because of their apparent value to wildlife, expansion of such habitats is proposed as a restoration concept for TWS24. The restoration action at TWS24 would include addition of clean, sandy fill within the area of upland phragmites in area 7. Raising the vertical elevation of the upland phragmites in area 7 approximately 2 to 4 vertical feet (bringing 7 to approximately the same elevation as areas 4 and 6) to a sufficient elevation with well to excessively-drained materials would preclude (or at least slow) future re-colonization of this area by phragmites; most importantly, it would provide suitable conditions for colonization by trees and shrubs, similar to those found on the high points of the site (i.e., areas 6 and 4; see Vegetation and Land Cover). This action could convert approximately about 3.5 acres of virtually unused upland habitat at the site to habitat valuable for native wildlife, including migratory songbirds, and mammals.

Prior to the addition of the fill within the upland phragmites area, the phragmites would be eradicated specifically within this parcel (area 7). It would also be prudent to eradicate at least an additional 100-foot buffer of phragmites along the edges of area 5 where areas 7 and 5 meet to help prevent re-colonization within the restoration area. Phragmites eradication would best be accomplished by aerial spraying of an herbicide agent containing glyphosate that is EPA-registered for use in aquatic and semi-aquatic environments.

After phragmites eradication is successful and complete, the newly-created area would be planted with native trees and shrubs. While natural colonization of these species probably would occur over time, planting would greatly help to ensure success of forested habitat establishment (and prevent establishment of undesirable species).

4.5.8 Project Implementation

The project would be timed so that it is implemented in the early fall and winter of the year (refer to next paragraph on phragmites removal). Area 7 would require 22,587 cubic yards of materials to raise it to approximately the same elevation as areas 4 or 6 (3.5 acres = 152,460 ft^2 feet X 4 vertical feet = 609,840 cubic feet = 22,587 cubic yards). The approximately 22,587 cubic yards of sandy materials could be added to the site using a small bulldozer, backhoe, or similar piece of equipment. The materials and equipment would likely have to be brought in by barge or similar craft to the site at its southeastern-most end, in the area where one of the existing high points (southern-most area 4) extends closest to the bank of Westecunk Creek. The equipment could be brought in over bog mats or similar structures to help protect the banks of the creek and the existing phragmites marsh from excessive compaction. Access to the site by equipment must be limited to one point to minimize impacts. The materials deposition would be performed from north to south.

Prior to addition of fill materials to the site, the phragmites eradication would take place. For the best effect of the glyphosate herbicide, spraying of the phragmites would take place from early to mid-September. This is because the best effect of the herbicide is achieved when transport of the photosynthesized sugars from the leaves of the plants to its rhizomes is maximized, reportedly during this time of year (Harriott and Burton 1997). Because of the open nature of the site, spraying could be accomplished either by fixed-wing craft or by helicopter (costs may be significantly lower by fixed-wing craft). For best success of removal, all phragmites eradication would be performed at one time (or on successive days). Proper care must be taken to closely follow all manufacturer application and safety guidelines, particularly regarding appropriate wind and climatological conditions. The dead phragmites stands would then be control-burned in the winter to remove dead standing canes (winter burning maximizes the number of dead phragmites canes), and to enhance the success of follow-up herbicide treatments. It is recommended that follow-up aerial herbicide and burning treatments be made with the same timing (i.e., early fall herbicide treatment and winter burning) over at least three successive years. In addition, site inspections must be made beginning in late spring after the first aerial application and burning to monitor the success of the phragmites eradication. Persistent problem areas after several treatments must be noted; these (smaller) areas would be hand-sprayed with backpack sprayers or similar devices.

After phragmites eradication is successful and complete, the newly-created area can be planted with native trees, shrubs, and herbaceous plants. These would include a mixture of the native species noted in upland habitats at several area sites, including bayberry (*Myrica pensylvanica*), groundsel bush (*Baccharis halimifolia*), black cherry (*Prunus serotina*), red maple (*Acer rubrum*), and beachgrass (*Ammophila breviligulata*). Assuming a minimal 250 plant-per-acre installation density, approximately 875 plants would be required for establishment of the 3.5-acre area.

Monitoring and maintenance of the site will involve a semi-annual inspection over at least three consecutive years to monitor the created habitats for success of the plantings and

phragmites eradication. An approximately 85 percent minimal survival rate of the plantings the third year after installation will be applied as a measure of success. Phragmites invasions onto the upland restored area would be mapped during the semi-annual inspections, for use in either successive aerial or hand applications of herbicide.

4.5.9 Potential Environmental Impacts

It is estimated that environmental impacts resulting from implementation of the three related projects will be primarily restricted to loss of a small amount of phragmites marsh vegetation (i.e., primarily phragmites) on the peripheries of the sprayed areas. One small parcel dominated by phragmites but also containing high tide bush (area 2) also borders area 7 to the east. This small area could be treated with herbicide by hand to minimize high tide bush mortality. Herbicides containing glyphosate are non-selective, and will slowly kill virtually all vegetation that they contact. Such losses will be minimized with the selection and use of the most appropriate spray equipment (e.g., spray nozzles, booms, etc.) and their use during optimal atmospheric conditions. Applied correctly in the appropriate concentrations, the herbicide is not anticipated to cause any negative effects to existing invertebrates, fish, and wildlife currently using the sites.

Other temporary impacts to the existing phragmites marsh on the southeastern end of the site may occur during movement of earth moving equipment onto the site. These effects, however, will be minimized with the use of appropriate protective devices (e.g., bog mats). Appropriate use of erosion and sediment control measures (e.g., silt fences, temporary berms, biologs, etc.) would minimize sedimentation impacts to the adjacent tidal marsh and other sensitive areas during the construction work.

Implementation of the project would not likely result in any additional significant positive or negative impacts relating to air quality and noise levels, water quality, wetlands and other special aquatic areas, finfish, including Essential Fish Habitat, wildlife resources including, but not limited to, the target species that have been identified, and threatened and endangered species.

4.5.10 Estimated Costs

The following approximate estimated costs relate to the principal elements of the project implementation at site TWS24, as stated above. The costs listed are approximate only, subject to change, and are primarily intended to provide perspective of the relative magnitude of the project. It must also be noted that where a range of costs for each item was available, the maximum cost was used. Note also that the clean, sandy materials removed from the three northern Westecunk Creek sites (TWS15, TWS17, and TWS18) could potentially be used as a nearby material source for restoration actions at TWS24, thus defraying costs.

Sandy material disposal/transportation/spreading:
22,587 cubic yards @ $35.00 per c.y. = $790,545

Phragmites eradication:

Aerial herbicide: 5 acres @ $79.00 per acre = $395.00 X 3 treatments = $1,185.00

Controlled burns: $800.00 X 3 visits = $2,400.00

Plant materials/installation/materials:

875 container seedling plants @ $3.00 each = $2,625.00

General labor 60 person-hours @ $35.00 per hour = $2,100.00

Bog mats = $1,000

Monitoring and maintenance:

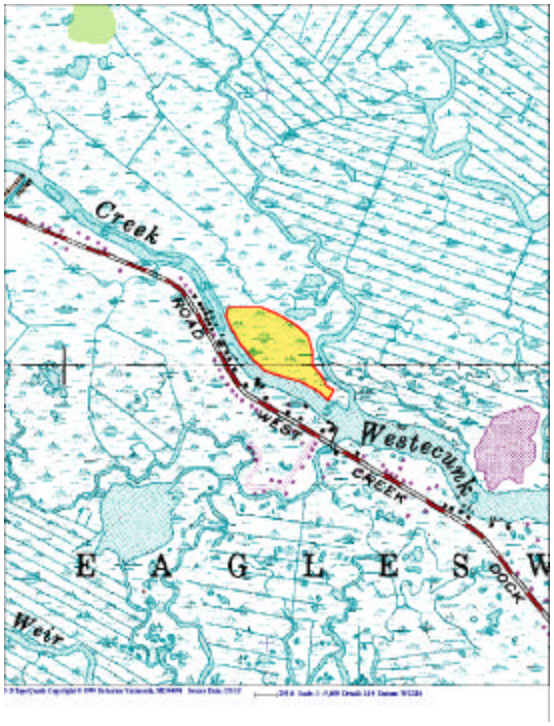
Phragmites mapping/backpack spraying: $800.00 X 6 visits = $4,800.00

GRAND TOTAL = $804,655

4.6 SITE TWS25 (SOUTH WESTECUNK CREEK)

4.6.1 Site Description and Ownership

Site TWS25 is owned by the USFWS and is included within the Edwin B. Forsythe Refuge system. It is located approximately 1.5 miles south of West Creek, New Jersey, on the north side of Westecunk Creek at its mouth, and is partially visible from West Creek Dock Road. The site is roughly rectangular in shape (longer east to west than north to south), and is a total of approximately 30 acres. The site has been used for the disposal of dredged material within the past 20 years; only one berm exists on the site, near its southern boundary on Westecunk Creek. TWS25 is highest in elevation on its berm and in the narrow area between the berm and Westecunk Creek (Figure 4-6) and lowest in elevation in the interior tidal marsh (area 3). It is by far the wettest of all 6 of the combined north and south Westecunk Creek sites, but the deposition of dredged material has isolated it from the tides. This site is somewhat closer to existing residences than the other two southern Westecunk Creek sites, because the creek is narrower here.



Substrate corings taken throughout the site and other measurements indicate that the fill in the highest part of the site (berm and area between berm and Westecunk Creek) is an average of about 2 to 3 feet above the undisturbed marsh adjacent to Westecunk Creek (this area is estimated to be about 1 acre total); the substrate in this area consists almost entirely of fine sandy silt. All of the other areas of the site are only 1 foot or less above the adjacent undisturbed marsh, and consist of fine sandy silt substrate. (refer to Appendix B, field data sheets). Groundwater was intercepted at about 18 inches on and adjacent to the berm, and was at or near the surface in the lowest areas (particularly area 3).

TWS25A. View looking northwest along the edge of site TWS25, at Westecunk Creek. Note the dense, monotypic phragmites in this part of the site.

TWS25B. View looking southwest at the phragmites on the berm along the Westecunk Creek side of the site. Note the dichotomy of the phragmites on the well-drained berm and within the area to the north of the berm.

4.6.2 Vegetation and Land Cover

The primary vegetation type at site TWS25 is phragmites marsh. Vegetation associations at the site are relatively simple compared to the other southern Westecunk Creek sites. The largest vegetation type on the site is phragmites marsh that is most often dominated by relatively weak monotypic phragmites (*Phragmites australis*) (area 1, Figure 4-6). The existing phragmites was largest and most dense on the berm and in the area between the berm and Westecunk Creek. Also present are several other marsh types where phragmites is co-dominant, including phragmites and salt water cordgrass (*Spartina alterniflora*) marsh (areas 4) and phragmites and high tide bush (*Iva frutescens*) marsh (area 2). Only one vegetation type (area 3) contains little phragmites, and is dominated by salt water cordgrass, interspersed with salt hay (*Spartina patens*).

The site is bordered in all directions except for the south by large areas of tidal marsh that are dominated by salt water cordgrass, salt hay, marsh spike grass, and high tide bush, with shallow isolated tidal pools and tidal creeks. Large areas of the marsh in the vicinity of this site were apparently never ditched (a very uncommon situation in the watershed); they appear diverse vegetationally and are undoubtedly very valuable habitats for wildlife. It is interesting to note that historic grid ditching for mosquito control stopped on the east side of the small unnamed tidal creek to the east side of the site.

4.6.3 Water Quality

Surface water quality was not measured at site TWS25 because no surface water features exist at the site and because extensive tests were done throughout Westecunk Creek and its unnamed tidal tributaries as part of the studies for the northern three Westecunk Creek sites and for TWS24 (refer to individual site descriptions and data sheets, Appendix B).

4.6.4 Wildlife

Wildlife and their signs (tracks, scats, calls, and other identifiable physical evidence) observed at the site while conducting the field studies included several individuals of only two species of birds; these were sharp-tailed sparrow (Ammospiza caudacuta), and marsh wren (Cistothorus palustris). Both of these species were noted in the phragmites/high tide bush marsh (area 2) in the northern-most part of the site, and in the spartina tidal marsh immediately to the north of the site. It is likely that both of these species nest in the direct vicinity of the site. It was noted that the current conditions on the site (i.e., low vegetative diversity, no open water, etc.) are not as conducive for many species of wildlife as they are in the unaffected tidal marshes immediately off the site. Because of their greater vegetative diversity and mixture of open water habitats, the undisturbed adjacent marshes likely contain excellent life requisite habitats for aquatic-oriented birds, fish, invertebrates, and other wildlife.

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Figure 4-6. Vegetation and land cover of site TWS25. Features were drawn in the field directly onto recent low-altitude, black and white, digitally rectified aerial photographs (USACE 1998). Wetlands vegetation and land cover types are indicated by an asterisk (*) in the legend.

4.6.5 Environmental Problems at the Site

Loss of Habitat from Dredging and Filling

The dredged material fill covers the entire 7 acres of the site; the fill was presumably placed directly over the original tidal marsh. The area with the greatest quantity of fill is on the berm and the area south of the berm to the creek; fill here is 2 to 3 feet above the undisturbed marsh adjacent to Westecunk Creek (this area is estimated to be about 1 acre total). All of the other areas of the site are only 1 foot or less above the adjacent undisturbed marsh. Area 3 is the part of the site with the least amount of fill (in some areas less than 1 foot).

Dominance by Phragmites

Site TWS25 is dominated by a dense (but weak) monotypic cover of phragmites (area 1) and other mixed phragmites communities (area 2 and area 4). The thin layer of fill in most areas prevents regular tidal exposure or inundation of the phragmites by the saline conditions of Westecunk Creek (on the order of about 16 to 18 parts per thousand). The phragmites in areas 4 and 2 is currently weak; in area 3 it is virtually nonexistent. As the site is apparently cut off from regular tidal fluctuation, however, it is presumed that the existing phragmites would become even further entrenched on the site without intervention, particularly in areas 4, area 2, and area 3. It has been demonstrated that phragmites can be easily and thoroughly killed when exposed to regular tidal flooding by waters with a salinity of at least 18 parts per thousand (Barrett and Niering 1993).

4.6.6 Restoration Constraints and Other Site Information

All of the land on the north side of Westecunk Creek in the vicinity of the southern sites is tidal marsh (the marsh here is apparently not freshwater as in the northern three sites, as evidenced by the *Spartina*-dominated plant community and the water chemistry results); on the south side of the Creek is Westecunk Creek Dock Road and residences. The closest residences exist within about 200 to 300 feet to the southwest of the site. "Aquatic Pesticide Permits," issued by NJDEP, Pesticide Control Program would be required for all the large-scale herbicide applications in the Barnegat projects. The spray permits are typically issued under a pesticide license maintained by the pilot or airport supplying the aircraft (personal communication, Eric Schrading, USFWS). No submerged aquatic vegetation was observed in any areas of Westecunk Creek or in the small, unnamed tidal creeks in the vicinity of the sites during the field studies.

It is critical to note that in recent meetings between the NJDEP Division of Engineering & Construction and USACE Operations (see minutes from 13 July and 20 July 2000, Appendix A), concerns were voiced that there may be a need for future dredged materials disposal on some parts or all of TWS25. It is not known at this time whether these future disposal actions would preclude all restoration activities at TWS25. At a total of only 7.2 acres, the site is relatively small, and would not present many restoration options if it were to be needed for future disposal needs.

According to the USFWS draft Forsythe National Wildlife Refuge management plan (USFWS 2000), these sites are slated for restoration. At this time, therefore, we see no obvious conflicts with other potential management plans for these sites.

4.6.7 Restoration Concept

Unlike the other two southern Westecunk Creek sites, TWS25 is relatively small, and is composed entirely of wetlands. This situation provides for fewer realistic restoration options. Because of the apparent high value of the adjacent unditched freshwater tidal marshes, however, restoring this site to its pre-disposal condition (i.e., remove fill) is entirely justified. Large areas of unditched tidal marsh are indeed a rarity in the Barnegat Bay study area, and these areas would be preserved to the maximum extent possible. It is assumed that after the fill materials are removed from the site, and it is re-exposed to the saline tidal waters, a suite of vegetation similar to that in the adjacent "unaffected marsh" (cordgrasses, bulrushes, swamp rose mallow, etc.; refer to Vegetation and Land Cover section) would colonize the site. The project would foster ecosystem diversity by replacing a relatively monotypic system (phragmites) that likely possesses little overall value to area wildlife with a diverse freshwater wetland system that is increasingly rare in the study area.

One growing season after removal of all fill materials at the site, any remaining phragmites would be eradicated. It is likely that successful fill removal at the site would restore a tidal connection to the saline waters of Westecunk Creek and the adjacent unnamed tidal creek (order of 16 to 18 parts per thousand), which would severely weaken phragmites. For the remaining phragmites, eradication would probably best be accomplished by aerial spraying of an herbicide agent containing glyphosate that is EPA-registered for use in aquatic and semi-aquatic environments.

After phragmites eradication is successful and complete, it is anticipated that natural colonization of the adjacent tidal marsh species vegetation (e.g., salt water cordgrass, salt hay, salt marsh spike grass, etc.) would occur fairly rapidly. The necessity of planting the site, therefore, is not anticipated.

4.6.8 Project Implementation

Approximately 14,843 cubic yards of material would have to be removed from the site (high part of area 1 = 1 acre = 43,560 ft^2 X 3 vertical feet = 130,680 cubic feet = 4,840 cubic yards. The remainder of the site is 6.2 acres = 270,072 ft^2 X 1 vertical foot = 270,072 cubic feet = 10,003 cubic yards. Combined, 4,840 c.y. + 10,003 c.y. = 14, 843 c.y.). The materials could be removed from the site using a small bulldozer, backhoe, or similar piece of equipment. Equipment would likely have to be brought in by barge or similar craft to the site along its southern end. Fill removal would then proceed generally from north to south. Because this project would involve fill removal only on the disturbed site wetlands (i.e., equipment would only be working from north to south in the fill removal area), no bog mats or other protective devices would be necessary.

Phragmites eradication would take place at the end of the first growing season subsequent to the fill removal. For the best effect of the glyphosate herbicide, spraying of the phragmites would take place from early to mid-September. This is because the best effect of the herbicide is achieved when transport of the photosynthesized sugars from the leaves of the plants to its rhizomes is maximized, reportedly during this time of year. Because of the open nature of the site, spraying could be accomplished either by fixed-wing craft or by helicopter (costs may be significantly lower by fixed-wing craft). For best success of removal, all phragmites eradication would be performed at one time (or on successive days). Proper care must be taken to closely follow all manufacturer application and safety guidelines, particularly regarding appropriate wind and climatological conditions. The dead phragmites stands would then be control-burned in the winter to remove dead standing canes (winter burning maximizes the number of dead phragmites canes) and to enhance the success of follow-up herbicide treatments. It is recommended that follow-up aerial herbicide and burning treatments be made with the same timing (i.e, early fall herbicide treatment and winter burning) over at least three successive years. In addition, site inspections must be made beginning in late spring after the first aerial application to monitor the success of the phragmites eradication. Persistent problem areas after several treatments must be noted; these (smaller) areas would be hand-sprayed with backpack sprayers or similar devices.

Monitoring and maintenance of the site will involve a semi-annual inspection over at least three consecutive years to monitor the created habitats for success of phragmites eradication and the re-colonization by native tidal marsh vegetation (e.g., salt water cordgrass, salt hay, salt marsh spike grass, etc.). It is anticipated that after fill removal and phragmites eradication, the site will be relatively quickly re-colonized by the native tidal marsh vegetation. An approximately 85 percent minimal total vegetative cover with less than about 5 percent phragmites will be applied as a measure of success at the site.

4.6.9 Potential Environmental Impacts

It is estimated that environmental impacts resulting from implementation of the project will be restricted to a small temporary loss of tidal marsh vegetation in the wetlands bordering the site, owing to the phragmites eradication. Herbicides containing glyphosate are non-selective, and will slowly kill virtually all vegetation that they contact. Such losses will be minimized with the selection and use of the most appropriate spray equipment (e.g., spray nozzles, booms, etc.) and their use during optimal atmospheric conditions. Applied correctly in the appropriate concentrations, the herbicide is not anticipated to cause any negative effects to existing invertebrates, fish, and wildlife currently using the sites.

Implementation of the project would not likely result in any additional significant positive or negative impacts relating to air quality and noise levels, water quality, wetlands and other special aquatic areas, finfish, including Essential Fish Habitat, wildlife resources including, but not limited to, the target species that have been identified, and threatened and endangered species.

4.6.10 Estimated Costs

The following approximate estimated costs relate to the principal elements of the project implementation at site TWS25, as stated above. The costs listed are approximate only, subject to change, and are primarily intended to provide perspective of the relative magnitude of the project. It must also be noted that where a range of costs for each item was available, the maximum cost was used.

Sandy material disposal/transportation/spreading:
14,843 cubic yards @ $35.00 per c.y. = $519,505

Phragmites eradication:
Aerial herbicide: 7 acres @ $79.00 per acre = $553.00 X 3 treatments = $1,659.00
Controlled burns: $800.00 X 1 visit = $800.00

Monitoring and maintenance:
Phragmites mapping/backpack spraying: $800.00 X 6 visits = $4,800.00

GRAND TOTAL = $526,764

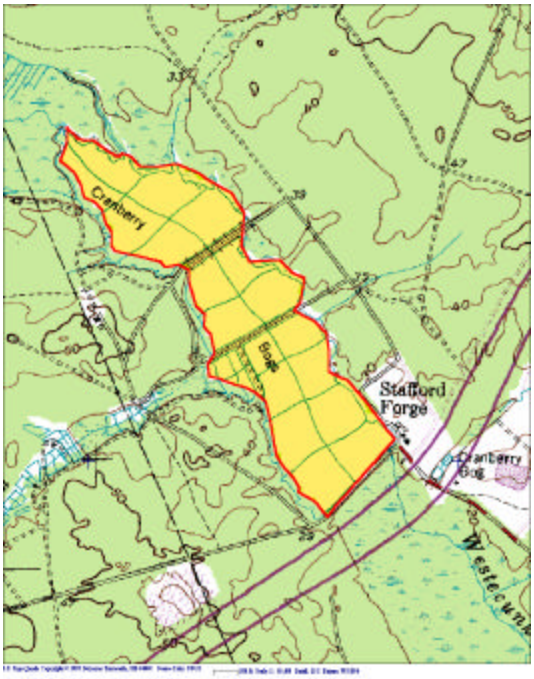
4.7 SITE NWS02 (STAFFORD FORGE WMA)

4.7.1 Site Description and Ownership

Site NWS02 is owned by NJDEP, Division of Fish, andWildlife. It is located about 2 miles north of West Creek, on Westecunk Creek, immediately north of the Garden State Parkway. The site is a former cranberry bog, now managed for wildlife by NJDEP and is a total of about 527 acres. According to NJDEP, the site was used as a bog operation as recently as the early-to-mid 1960s (personal communication, D. Wilkinson, NJDEP). The site consists of a series of 5 very large ponds (these were named ponds #1 through #5, from north to south); two ponds are directly on-line with Westecunk Creek, and three are off-line. Westecunk Creek flows onto the site at the northern-most part of pond #1 and south through the eastern side of the site; Governors Branch flows onto the site at the southwestern corner of pond #1.

The Stafford Forge site is surrounded by very large areas of dry, upland pine-oak forest that has been managed by NJDEP for wildlife and hunting. Water levels have been manipulated in the 5 on-site ponds by NJDEP, but the degraded water-control structures now make such changes difficult. Many of the structures are partially functional or non-functional. The main water control structure at the southern end of pond #5 on Forge Road is dilapidated and needs to be replaced. NJDEP is currently reviewing plans to replace this and possibly other structures.

During several meetings about the Stafford Forge site, USACE and NJDEP Fish and Wildlife, indicated that they were willing to partner on restoration at the site as part of their upgrades to the water control structures. Specific elements discussed included installation of two fish ladders on Westecunk Creek for migration of anadromous fish (alewife), partial or full draining of ponds #2 and #3 (and possibly within part of pond #5) for establishment of emergent wetlands, and restoration of Atlantic white cedar wetlands along Westecunk Creek corridor on the east side of the site. These elements are discussed individually in the sections below.



Measurements of the berms and roads separating the 5 ponds were taken and all water control structures were measured and characterized during the fieldwork. Because of the large number of measurements and structures, this information is not presented here. Refer to Appendix B for the field data sheets for site NWS02.

NWS02A. View looking northwest through the main water control structure immediately north of Forge Road, on Westecunk Creek, at site NWS02. The structure was originally placed on the creek as part of the cranberry bog operations here (now abandoned). The timber structure retains water in the southern-most pond at the site, and presents a blockage to the movement of fish, eels, and other aquatic organisms on the waterway.

NWS02B. View from the southwestern corner of the northern-most (triangle-shaped) pond at NWS02, looking northeast. The pond level was relatively low at the time the photo was taken. Note the scrub-shrub wetlands (foreground of photo) and the herbaceous wetlands (midground of photo).

NWS02C. Detail view of dilapidated water control structure on the berm that drains the northern-most pond to the next pond to the south. The berm size and conditions depicted are similar to those throughout the site. Note the Atlantic white cedars that grow near the bases of the berms and the tannic color of the water.

4.7.2 Vegetation and Land Cover

The primary vegetation type at NWS02 is upland pine-oak forest (areas 6, Figure 4-7). The dry forest is dominated by pitch pine (*Pinus rigida*) and several oak species, including scrub oak (*Quercus ilicifolia*), blackjack oak (*Quercus marilandica*), black oak (*Quercus velutina*), and white oak (*Quercus alba*). The forest possesses a dense shrub layer of lowbush blueberry (*Vaccinium angustifolium*) and huckleberry (*Gaylussacia baccata*). The herbaceous layer in the forest was very sparse to nonexistent; bracken (*Pteridium aquilinum*) is the only common herbaceous plant. Large areas of the forest on the west side of the site burned in a fire several years ago and are still re-generating.

The second-largest vegetation type at NWS02 is a shrub/scrub-Atlantic white cedar wetland association that dominates the majority of the northwestern part of the site and several smaller parcels along Westecunk Creek in the eastern part of the site (areas 1). The shrub-scrub is dominated in most areas of the site by a mixture of ericaceous shrubs such as maleberry (*Lyonia ligustrina*), dwarf huckleberry (*Gaylussacia dumosa*), highbush blueberry (*Vaccinium corymbosum*), and large cranberry (*Vaccinium macrocarpon*), as well as other species such as speckled alder (*Alnus rugosa*) and sweet pepperbush (*Clethra alnifolia*). Many of the shrub-dominated areas of the shrub-scrub also possess an herbaceous understory of wooly sedge (*Carex lanuginosa*) and several other sedges. Other areas of the shrub-scrub are dominated by

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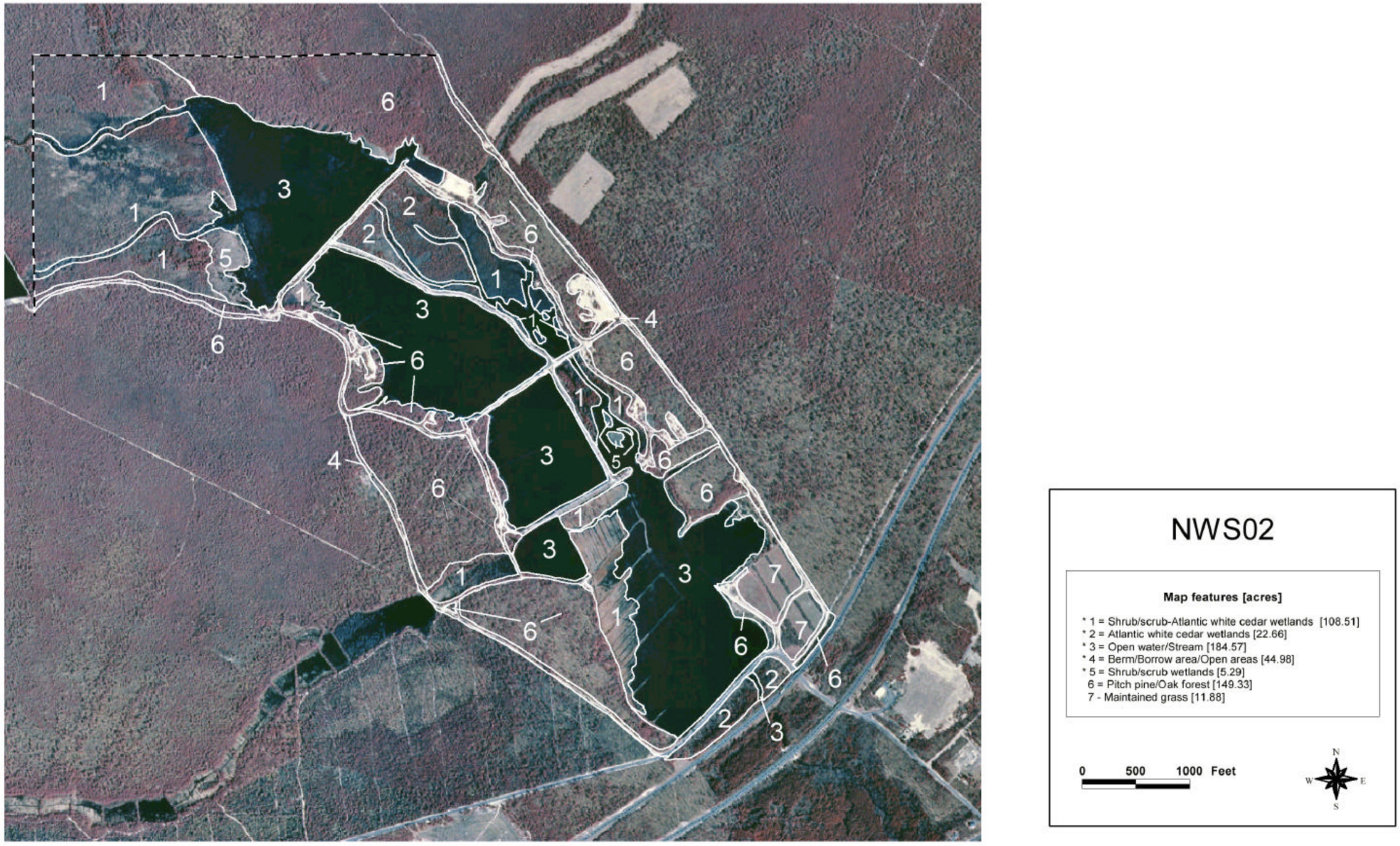


Figure 4-7. Vegetation and land cover of site NWS02. Features were drawn in the field directly onto recent low-altitude, black and white, digitally rectified aerial photographs (NJDEP 1997). Wetlands vegetation and land cover types are indicated by an asterisk (*) in the legend.

small Atlantic white cedar (*Chamaecyparis thyoides*) and red maple (*Acer rubrum*) trees with little understory. The areas possessing trees are scattered throughout the shrub-scrub.

Also present at the NWS02 site are two variations of the shrub/scrub-Atlantic white cedar wetlands; these include Atlantic white cedar wetlands and shrub/scrub wetlands. The principal species in these variations are essentially the same as those in the principal type (see above), but vary in dominance. The Atlantic white cedar wetlands (areas 2) are clearly dominated by dense stands of Atlantic white cedar, and possess very sparse shrub and herbaceous understories. In contrast, the shrub/scrub wetlands (areas 5) are composed of dense areas of shrubs with almost no cedars, interspersed with patchy, herb-dominated areas.

One large area of maintained grass exists in the southeastern corner of the NWS02 site (area 7). This area is all upland and consists of planted, mowed grasses with linear rows of planted autumn olive shrubs (*Eleagnus umbellata*). It was presumably created as wildlife habitat for rabbits and white-tailed deer.

Other areas of the site also possess large areas of unvegetated open water in the creek corridor and open ponds (areas 3). A substantial number of man-made berms and dirt roads are also found throughout the site (areas 4). Many of the berms are very substantial, and are 9 to 10 feet tall. Several old borrow areas also exist along the dirt roads, where material was excavated for construction of the many berms and roads at the site.

4.7.3 Water Quality

Surface water quality was measured at eight locations on the NWS02 site and within the near watershed (refer to Section 1 for a description of the equipment used); Table 4-5 presents results. In addition, physical stream habitat assessments were conducted at two locations, one in the headwaters of Westecunk Creek, and another on Westecunk Creek immediately below the site (below Forge Road; refer to Appendix B for field data sheets).

Several items of note were discovered during the water quality data collection in the vicinity of NWS02. The pH of Westecunk Creek was always acidic; it was less than 5.0 throughout the area of the site, and was less than 4.0 in some areas of the headwaters. The water temperature in the headwaters of the creek was relatively cold (at about 14°C), and could be considered a cool water system; flow was also relatively swift. Not surprisingly, the water temperature was significantly warmer in the large, relatively shallow ponds on the site. Water temperature downstream of NWS02 at site NWS03 (about 2 miles downstream) was 5 degrees cooler, but was relatively the same pH (refer to NWS03 data sheets, Appendix B). No eutrophication was evident in any of the large ponds on the NWS02 site.

Physical habitats in the headwaters of Westecunk Creek are of relatively high quality, appear to be well-protected within the wildlife management area, and are generally well-buffered from roads and development. They rated “optimal” for epifaunal substrate/available cover, pool variability, sediment deposition, channel flow status, channel alteration, bank stability,

vegetative protection, and riparian vegetative zone width categories. It was noted, however, that green filamentous algae was thick in the reach of stream that was sampled; it is not known whether other upstream reaches also possess the algae, or how the algae affects water quality in the creek. Physical habitats below the NWS02 site also rated optimal for most categories of physical habitats, with a few exceptions. Immediately below the site the creek is somewhat channelized (likely caused by the upstream impoundment and the existing roadways, i.e., Forge Road and the Garden State Parkway), and the riparian vegetative zone is less than an optimal width. Other than those relatively minor factors, the creek possesses relatively optimal physical habitats.

Table 4-5. Results of water quality testing done at Site NWS02 for the Barnegat Environmental Testing field studies.

Sampling Location	pH	Salinity (o/oo)	D.O. (mg/L)	Specific Conductivity (mS/cm)	Temp (°C)	Turbidity (NTU)
W1 (Governors Branch, above site at Route 539; surface)	4.21	0.01	9.81	0.034	14.14	18.8
W2 (Westecunk Creek, above site off Sims Place Road; surface)	3.77	0.02	8.48	0.045	13.85	18.2
W3 (Westecunk Creek, immed. below pond #1; surface)	4.22	0.01	9.68	0.030	19.71	18.5
W4 (Pond #1, SE corner; surface)	4.92	0.02	8.61	0.036	22.30	20.4
W5 (Pond #2, SW edge; surface)	4.65	0.01	10.42	0.035	21.37	20.3
W6 (Pond #3, SW edge; surface)	4.73	0.02	10.51	0.037	22.05	18.0
W7 (Westecunk Creek, large berm breach immed. above Pond #1; surface)	4.85	0.01	8.89	0.030	22.65	19.3
W8 (Westecunk Creek, immed. downsteam of site; surface)	4.55	0.01	9.84	0.029	22.36	18.7

4.7.4 Wildlife

Wildlife and their signs (tracks, scats, calls, and other identifiable physical evidence) were observed at and near site NWS02 while conducting the field studies. These included Great egret (*Casmerodius albus*), snowy egret (*Egretta thula*), great blue heron (*Ardea herodias*), mute swan (*Cygnus olor*), mallard duck (*Anas platyrhynchos*), black duck (*Anas rubripes*),

brown thrasher (*Toxostoma rufum*), prairie warbler (*Dendroica discolor*), pine warbler (*Dendroica pinus*), white-eyed vireo (*Vireo griseus*), rufous-sided towhee (*Pipilo erythropthalmus*), house wren (*Troglodytes aedon*), painted turtle (*Chrysemys picta picta*), and mud turtle (*Kinosternon subrubrum subrubrum*). In addition, evidence of beaver (*Castor canadensis*), and white-tailed deer (*Odocoileus virginianus*) was abundant throughout the site and the upper watershed. The great egrets, snowy egrets, and great blue herons were observed in pond #1. Several mute swans were observed on pond #1 during several winter 1999 visits to the site. Black ducks and mallard ducks were observed in pond #1 and pond #5; mallard ducks were also observed in other locations in the upper Westecunk Creek watershed. Pine warblers, prairie warblers, white-eyed vireos, and rufous-sided towhees were heard and observed in the recently burned pine/oak forest along the west-central section of the site. One brown thrasher was observed along an access road adjacent to Governors Branch. Several house wrens were heard and observed in the open, maintained grassy area in the southeastern corner of the site. Several painted turtles were observed basking near the southwestern corner of pond #1. One mud turtle was observed in the shrub/scrub wetland immediately east of pond #4. Two apparently current beaver lodges were observed on the east side of pond #4; beaver-related damage was also apparent on several adjacent trees (no direct sightings were made, however). Evidence of white-tailed deer was abundant throughout the site, although no direct sightings were made during the field studies.

It should be noted that, despite the presence of a large quantity of open fresh water at the site, surprisingly few ducks, waterfowl, and aquatic birds in general were observed at the Stafford Forge site during at least 10 visits to the site in the fall, winter, spring, and summer months. The NJDEP Division of Fish and Wildlife has confirmed that the ponds are generally little-used, with the occasional exception of pond #1 and pond #5; these are intermittently used by dabbling ducks such as blue-winged teal (*Anas discors*), and American wigeons (*Anas americana*) (personal communication, W. Tonneson, NJDEP). In addition, NJDEP has indicated that the fishery is generally very poor throughout all of the ponds at NWS02 (personal communication, H. Carberry, NJDEP).

4.7.5 Environmental Problems at the Site

<u>Loss of Habitat from Hydrological Modifications</u>

The construction of berms and placement of water control structures for cranberry production at the site flooded valuable stream, wetland, and upland habitats and replaced them with relatively sterile open water habitats. A significant amount of Atlantic white cedar wetlands were apparently lost by flooding of the ponds and stream habitats. The water control structures also serve as barriers to anadromous (herring), catadromous (eel), and resident fish populations on Westecunk Creek (refer to analysis for site NWS03; section 4.12.4). The open water habitats provide a very poor fishery and are surprisingly little-used by ducks, waterfowl, and other wildlife.

Degradation of Water Quality

Ponded, converted stream habitats such as NWS02 add to the deterioration of local water quality in Westecunk Creek, and ultimately in the Bay. This is primarily because they are broad, poorly-flushed environments where dissolved oxygen is lowered, and temperatures and nutrient levels are raised. In addition, the physical habitats of Westecunk Creek have been altered immediately above and below the site, further exacerbating water quality problems. The natural Atlantic white cedar wetlands that protected water quality and buffered the creek were largely removed and replaced with the large open water ponds as part of the former cranberry bog operation.

4.7.6 Restoration Constraints and Other Site Information

The New Jersey Natural Heritage database indicates that recent records exist for one plant, Knieskern's beaked rush (*Rhynchospera knieskernii*) on the site. In addition, the records indicated two animals, pine barrens tree frog (*Hyla andersonii*), and Cooper's hawk (*Accipiter cooperii*), are also present at the site. According to these records, Knieskern's beaked rush was observed in 1994 adjacent to the northern-most pond; this species is listed as federal Threatened and state Endangered, and is extremely rare throughout its entire naturally occurring range. Pine barrens tree frog was apparently recorded in several locations within Stafford Forge in 1990; this species is listed as state Endangered, but is apparently secure throughout other parts of its naturally occurring range. One pair of nesting Cooper's hawks were recorded in 1995 within Stafford Forge, along Old Forge Road to the north of the northern-most bog; this species is listed as state Threatened, but is secure within other parts of its naturally occurring range. No additional data is currently available on the status of these species at Stafford Forge. None of these species were observed on numerous visits to the site during the field studies. Because of the nature of the proposed restoration at Stafford Forge, it is unlikely that any of these three species would be negatively affected. Knieskern's beaked rush was recorded in one location to the north of the northern-most pond, an area that would be little-affected by the proposed restoration. The proposed restoration would not likely either improve or degrade conditions on the site for Cooper's hawk. Restoration of some of the Atlantic white cedar wetlands on the site could slightly improve habitats for the pine barrens tree frog, but this would not be a major component or result of the work.

The primary constraints with the NWS02 site relate to the fact that the NJDEP, Division of Fish and Wildlife has a significant long-term investment in the dikes, structures, and other resources at the site. Based on meetings and discussions with the Division of Fish and Wildlife, they are interested in maintaining some of the open water areas in their existing uses for flood control and waterfowl. It is also believed that it may be advantageous from a fisheries perspective to maintain pond #5 as open water. If fish ladders are used at the site to provide for anadromous fish passage, pond #5 would provide an ideal resting area for upstream-migrating adult fish and for fry returning downstream; passage success would be greatly reduced without this amenity (personal communication, H. Carberry, NJDEP).

Another constraint with respect to re-establishment of the anadromous fishery is that restoration would have to proceed at site NWS03 for the restoration at Stafford Forge to be successful. Site NWS03 is about 2 miles downstream of Stafford Forge, and poses at least a partial blockage (and likely full blockage during low-flow conditions) to upstream-migrating fish. The restoration at NWS03 would only require removal of several small concrete structures in the stream, however, and is not viewed as a technically difficult (or expensive) project. The structures are a relic of a historic cranberry operation adjacent to the creek and serve no current function. The NWS03 structures lie in the creek (owned by the state); the structures themselves are privately owned, however, so some uncertainties exist.

Also with regard to anadromous fishery issues is the water chemistry at and upstream of the site. The pH is relatively low (below 5.0 in many areas) and there has been discussion regarding the potential success of establishment of the fishery. Almost no historic information exists on the anadromous fishery in the creek. NJDEP has indicated that they would require further data-gathering on creek pH, as well as gill-netting prior to the initiation of the restoration. Recent anecdotal information, however, from reliable professional anglers in the vicinity of the site indicate that alewife exist to the base of the NWS03 site (Personnal communication, W. Tonnesen, NJDEP). From the field studies in this area, the creek water chemistry is not substantially different at the NWS03 and NWS02 sites, and into the headwaters. Further, the physical habitat upstream of NWS02 on Westecunk Creek appears to be excellent. These factors appear to indicate that establishment of an anadromous fishery is tenable on Westecunk Creek by implementation of the restoration at sites NWS02 and NWS03. Finally, while the anadromous fishery could be somewhat limited by water chemistry, passage at site NWS02 would also provide for free movement of other native non-anadromous and catadromous fish and benthos.

The Division of Fish and Wildlife has also indicated that any restoration efforts would include beaver exclusion devices or techniques where appropriate (personal communication, R. Porutski, NJDEP). Beavers have apparently gotten very numerous in the vicinity of the site in the past 5 years; they build dams and structures that interfere with drainage, and are considered pests. The Division of Fish and Wildlife also indicated that both fish ladder structures must be securely fenced to prevent illegal alewife poaching and potential safety concerns.

4.7.7 Restoration Concept

The concepts for restoration at NWS02 include establishment of an anadromous fishery in Westecunk Creek, conversion of several of the large open water ponds to herbaceous wetlands, and enhancements to the on-site Atlantic white cedar wetlands along the east-central part of the site. Other benefits would likely be realized as part of the restoration, including freedom of movement for non-anadromous fish and benthos, and improved water quality and physical stream habitat.

The existing dilapidated main water control structure on pond #5 at Forge Road would be replaced with a new structure that includes an integrated, pre-fabricated fish passage structure. Likewise, the main water control structure on the southeastern side of pond #1 would be replaced with a new structure that also includes an integrated, pre-fabricated fish passage structure. Few

other physical changes would have to be done to establish the anadromous fishery. After installation of the ladders, the creek would have to be "seeded" by hatchery fish for at least 3 years prior to establishment of an anadromous population of alewife.

To convert some of the existing open water habitats to vegetated wetlands, sets of culverts with water control structures would be installed in the berms between pond #2 and pond #3 and Westecunk Creek. The structures would allow for draining of pond #2 and pond #3 to several inches of water (according to NJDEP they are currently an average of 5 to 6 feet deep) so that rooted wetland vegetation can colonize these areas. It should be noted that a similar condition exists in the northern and western sides of pond #1, where herbaceous and scrub/shrub wetlands have become dominant. As previously indicated, beavers have become a nuisance in the vicinity of the site; these structures would include beaver exclusion devices, if possible. With the water control structures in place, the ponds could be drained during normal creek flows, but could also be flooded during brief periods of high flow.

For restoring the existing shrub scrub and Atlantic white cedar wetlands (mapped as areas 1, 2, and 5 along Westecunk Creek on the east side of the site), Atlantic white cedars could be planted over about 8 acres of the eastern section of the site. The cedars could be planted as sapling trees with special protective sleeves to lower mortality by herbivores such as white-tailed deer and beaver. From observations made during the field studies at Stafford Forge, an estimated 5 to 8 acres could be planted with cedars.

4.7.8 Project Implementation

New water control structures with integrated fish ladders would be installed simultaneously at Forge Road on pond #5 and at the southeastern end of pond #1. Because the new structures would be installed from the existing roadways, no existing wetland, aquatic, or terrestrial communities would likely be affected by their installation or operation. It is assumed at this time that both of the fish ladder/water control structures would be prefabricated and would be installed for a lump sum. The use of best management practices and soil erosion and sediment control techniques would minimize the temporary impacts to Westecunk Creek during the construction process. At the 16 August 2000 meeting with the Division of Fish and Wildlife (see meeting notes, Appendix A), they indicated that the approximately 3-year process of "seeding" alewife gravid adults above the Stafford Forge site would be performed by the Division of Fish and Wildlife; the implementation and costs for this aspect of the restoration would be incurred by the Division.

If properly placed, the water control structures between ponds #2 and #3 and Westecunk Creek could be installed from the existing roadways there. It is currently presumed that prefabricated structures could be used at both ponds #2 and #3, and that each of the structures would use a simple intake structure system with round or ovalized metal pipes with manually-operated water-control gates. The southeastern ends of both ponds #2 and #3 possess no vegetated wetlands on the creek side of their access roads. Providing the structures could be installed in these locations, no existing wetland, aquatic, or terrestrial communities would likely be affected by their installation or operation. It would be most prudent if ponds #2 and #3 were

drained very slowly into the creek, to prevent erosion within the existing creek system. Best management practices would also likely dictate the use of silt curtains, staked hay bales, and other anti-erosion methods to protect the creek during draining. After the ponds have been drained, they would be allowed to vegetate naturally (an abundant seed source exists in the northwestern corner of pond #2 and in the western part of pond #1). The project would have to be carefully inspected at least semi-annually to prevent permanent colonization by invasive species (e.g., phragmites and purple loosestrife).

It is assumed that it will be appropriate to restore Atlantic white cedar within a total of approximately 8 acres along the eastern section of the site. If containerized sapling cedars were planted at a density of approximately 200 per acre, this would equate to planting about 1,600 Atlantic white cedar trees. Under ideal conditions, this quantity of sapling trees could be planted by hand with a crew of 4 persons in a week or less.

Monitoring and maintenance of the restored NWS02 site will require long-term (but not necessarily complex) studies of the anadromous fishery, as well as monitoring of the created vegetated wetlands habitats in ponds #2 and #3 and the planted Atlantic white cedars along Westecunk Creek. The (drained) habitats in ponds #2 and #3 would also have to monitored at least semi-annually to ensure that invasive plants such as phragmites and purple loosestrife do not become dominant.

4.7.9 Potential Environmental Impacts

Because of the specific nature of the existing Stafford Forge site and the proposed elements of restoration, it is presumed that the restoration could be performed with a minimum of ecological impact to the aquatic and terrestrial environments. All of the proposed water control structures would either replace existing structures or would be installed in existing upland berms. Installation of the two water control/fish ladder structures would provide passage of both anadromous and non-anadromous fish, allowing for the potential movement of these fish from the Bay into the headwaters of Westecunk Creek and back. Water control structures installed between ponds #2 and #3 would allow for establishment of a relatively large quantity of herbaceous wetlands from what is now relatively sterile open water habitat. This habitat would provide a potential food resource for many species of waterfowl and aquatic birds. Planting of Atlantic white cedar saplings would also help to re-establish an important ecological habitat that was lost when the cranberry bogs were created 40 years ago.

With implementation of appropriate best management practices and soil erosion and sediment control measures, the proposed activities would likely pose minimal impacts on the existing ecological resources. Such measures could include use of silt curtains, hay bales, temporary seeding of steep exposed slopes, etc.

Implementation of the project would not likely result in any additional significant positive or negative impacts relating to air quality and noise levels, water quality, wetlands and other special aquatic areas, finfish, including Essential Fish Habitat, wildlife resources including,

but not limited to, the target species that have been identified, and threatened and endangered species.

4.7.10 Estimated Costs

The following approximate estimated costs relate to the principal elements of the project implementation at site NWS02, as stated above. The costs listed are approximate only, subject to change, and are primarily intended to provide perspective of the relative magnitude of the project. In addition to the specified costs, additional costs ranging from roughly $2,000 to $20,000 would likely need to be spent for seeding the watershed above Stafford Forge with gravid adult alewife. These costs, to be incurred by the NJDEP Division of Fish and Wildlife, will vary greatly, depending on conditions present during collection of fish in preparation for the seeding. It must also be noted that where a range of costs for each item was available, the maximum cost was used.

Installation of pre-fabricated fish ladder/water control structures:
2 structures and labor = $200,000

Installation of water control structures on ponds #2 and #3:
2 structures and labor = $150,000

Planting of Atlantic white cedar (8 acres):
1,600 containerized saplings @ $5.00 each = $8,000
labor, 240 person-hours @ $35.00 per hour = $8,400

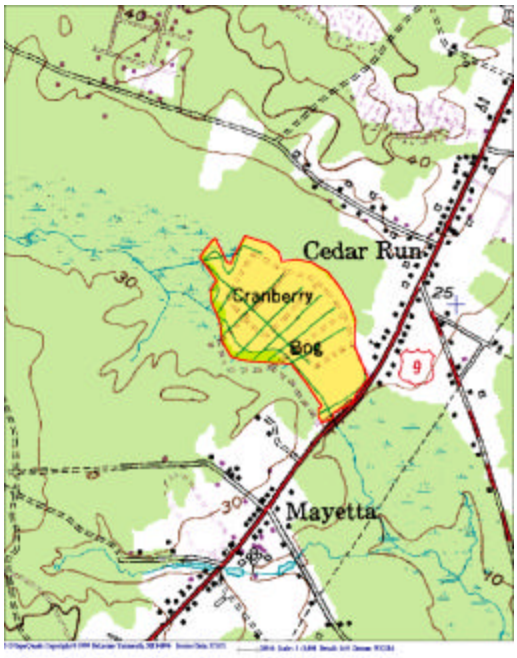
Monitoring and maintenance:
Site inspections and monitoring: $800.00 X 6 visits = $4,800.00

GRAND TOTAL = $371,200

4.8 SITE NWS01 (CEDAR RUN ABANDONED CRANBERRY BOG)

4.8.1 Site Description and Ownership

Site NWS01 is owned by the USFWS and is included within the Edwin B. Forsythe Refuge system. It is located about 0.5 mile south of the Route 72 and Route 9 interchange (south of Manahawkin, immediately west of Route 9). The site is a former cranberry bog, now owned and managed for wildlife by USFWS; the site as mapped is about 60.3 acres. The site consists of two large, shallow, partially vegetated open water ponds on Cedar Run, two large sedge meadows (former drained ponds), and several parcels of herbaceous wetlands. The site is bordered to the north, east, and northwest by Atlantic white cedar forest, and to the southwest by upland mixed deciduous forest. Route 9 is located to the immediate south/southeast of the site.



The main berms and roads separating the ponds were measured and the water control structure was measured and characterized during the fieldwork. The two main berms that separate the ponded areas are about 17 feet wide and 16 inches above the existing water surface. Some areas of the berms are so eroded and are so low (i.e., close to groundwater level) that Atlantic white cedars and other wetland vegetation grow along their sides. Several of the berms are partially or completely breached. The pond level at the water control structure on Cedar Run, immediately north of Route 9, is 25 inches above the downstream side (i.e., 25 inch drop); it is a relatively simple weir with removable six-inch-wide boards for controlling the pond level. Refer to Appendix B for the field data sheets for site NWS01.

NWS01A. View looking northwest through the dilapidated timber water control structure on Cedar Run at the NWS01 site. The structure was originally placed on the creek as part of the cranberry bog operation here (now abandoned); it is now partially breached.

NWS01B. View looking northwest from atop the water control structure, looking over the ponded area of Cedar Run. Note the submerged aquatic vegetation in the open water and the herbaceous emergent wetlands along the edges of the water.

NWS01C. View looking southeast on Cedar Run, immediately downstream of the water control structure at NWS01. The Atlantic white cedar wetlands and shrub-scrub wetlands present in this photo likely represent the relatively undisturbed vegetative community that existed at the NWS01 site prior to cranberry farming activities 40 to 50 years ago.

4.8.2 Vegetation and Land Cover

The primary vegetation type at NWS01 is Atlantic white cedar wetlands. The Atlantic white cedar wetlands (areas 1; Figure 4-8) are clearly dominated by dense stands of Atlantic white cedar (*Chamaecyparis thyoides*), with occasional small red maple (*Acer rubrum*) trees; they typically possess only very sparse shrub and almost non-existent herbaceous understories. The dominant shrubs in the Atlantic white cedar forest are highbush blueberry (*Vaccinium corymbosum*) and sweet pepperbush (*Clethra alnifolia*); occasionally speckled alder (*Alnus rugosa*) is also present.

Several large areas of sedge meadows (areas 4) exist in the north-central part of the site in former cranberry production areas that have been somewhat drained. The sedge meadows are clearly dominated by one species, wooly sedge (*Carex lanuginosa*). These areas also possess an occasional understory of large cranberry (*Vaccinium macrocarpon*). Despite being somewhat drained, these areas still possess several inches to a foot of standing water.

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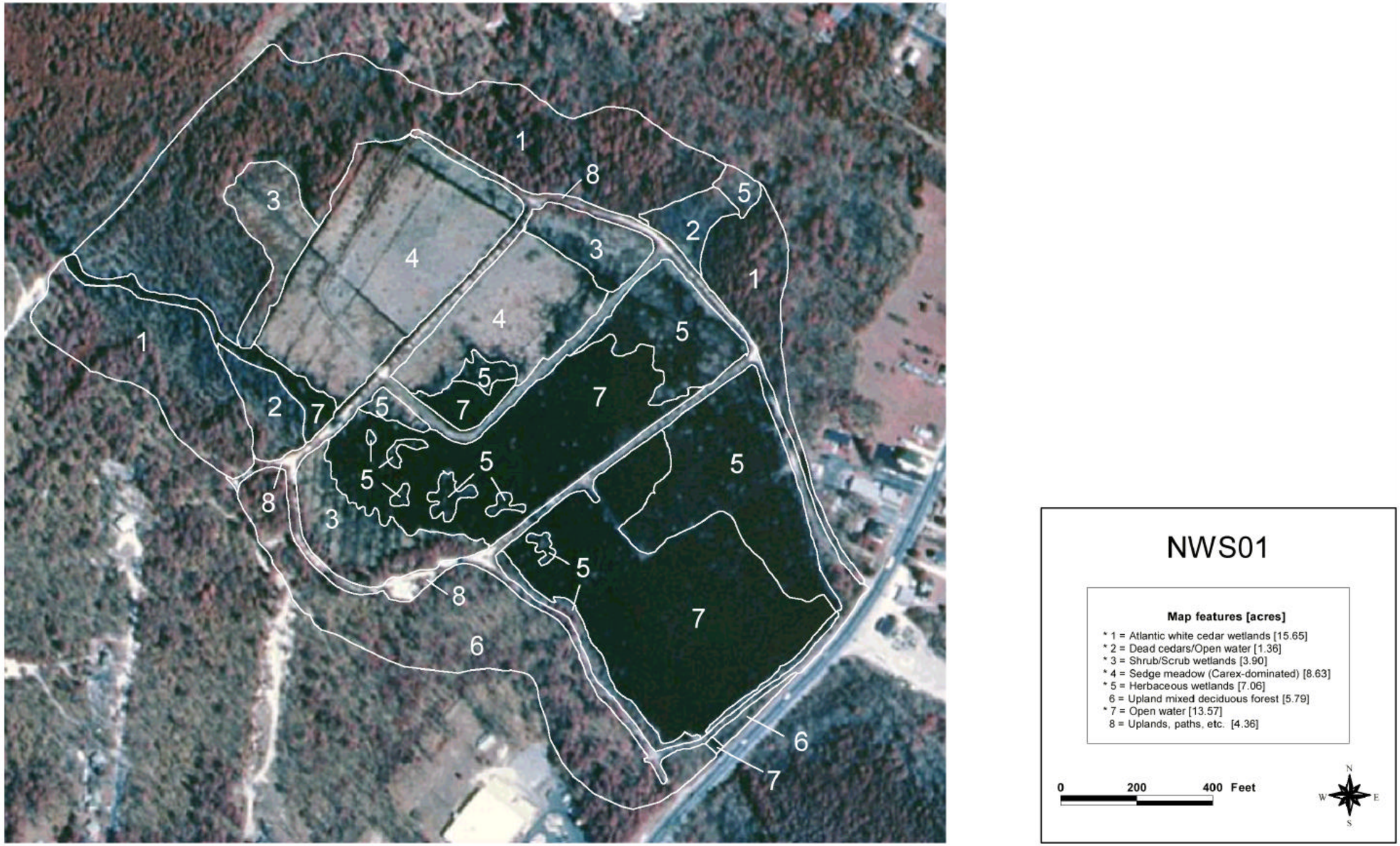

Figure 4-8. Vegetation and land cover of site NWS01. Features were drawn in the field directly onto recent low-altitude, black and white, digitally rectified aerial photographs (NJDEP 1997). Wetlands vegetation and land cover types are indicated by an asterisk (*) in the legend.

Three moderately large areas of shrub/scrub (areas 3) exist in the northern, western, and eastern parts of the site. These areas are characterized by a mixture of shrubs, small trees, and herbaceous plants. The dominant shrubs and woody vines in the shrub/scrub include highbush blueberry (*Vaccinium corymbosum*), maleberry (*Lyonia ligustrina*), speckled alder (*Alnus rugosa*), sweet pepperbush (*Clethra alnifolia*), and large cranberry. Scattered small trees are also present; these include Atlantic white cedar, red maple, and black gum (*Nyssa sylvatica*). The herbaceous layer includes marsh fern (*Thelypteris palustris*), sphagnum mosses (*Sphagnum* spp.), sallow sedge (*Carex lurida*), wooly sedge, and bushy broomsedge (*Andropogon glomeratus*).

Many scattered parcels of herbaceous wetlands (areas 5) exist adjacent to the open water of the site. The parcels are generally very small, but several large parcels exist in the southeastern part of the site. These wetlands possess a variety of herbaceous vegetation, including spatulate leaved sundew (*Drosera intermedia*), thread leaved sundew (*Drosera filiformis*), round leaved sundew (*Drosera rotundifolia*), and pitcher plant (*Sarracenia purpurea*). Also present in these areas are bushy broomsedge, woolgrass (*Scirpus cyperinus*), and wooly sedge. Many of these areas also contain significant amounts of large cranberry. Scattered small red maple and Atlantic white cedar trees are also present along the edges of the herbaceous wetlands.

Upland mixed deciduous forest (area 6) is mapped as a long, narrow parcel along the southern part of the NWS01 site. The forest on the site exists on a relatively steep ridge; it appears unusually steep for this geographic region, and may have resulted from excavation activities when the bog was constructed. This area is dominated by a number of oaks, including white oak (*Quercus alba*), scrub oak (*Quercus ilicifolia*), southern red oak (*Quercus falcata*), and chestnut oak (*Quercus prinus*), as well as pitch pine (*Pinus rigida*). The upland forest possesses a moderately dense shrub and wood vine layer; predominant species include maple-leaved viburnum (*Viburnum acerifolium*), black huckleberry (*Gaylussacia baccata*), lowbush blueberry (*Vaccinium angustifolium*), and common greenbrier (*Smilax rotundifolia*). The only commonly observed herbaceous plant in the upland forest was bracken (*Pteridium aquilinum*).

Two small areas of dead Atlantic white cedars (areas 2) in standing open water exist along the eastern and western edges of the site. Very little live vegetation was present in these two parcels; these are apparently areas that the cedars colonized during dry years and subsequently died back in wet years when standing water was constantly present. Other vegetation and land cover types include the open water of Cedar Run and the bog's ponds (areas 7), and the upland paths and roads that are remnants of the bog operation (areas 8). The shallow open water habitats at the site possess dense growths of SAV, as well as floating aquatic vegetation, and rooted emergent aquatic vegetation. Some of the species observed include sago pondweed (*Potamogeton pectinatus*), water celery (*Vallisneria americana*), fragrant water lily (*Nymphaea odorata*), and common water plantain (*Alisma plantago-aquatica*). Very little vegetation was observed on the paths at the site, with the exception of low, wet areas where a suite of vegetation similar

to those in the on-site herbaceous marsh was present; Atlantic white cedars were also present in the wet areas.

4.8.3 Water Quality

Surface water quality was measured at four locations on the NWS01 site and within the near watershed (Table 4-6; refer to Section 1 for a description of the equipment used). In addition, physical stream habitat assessments were conducted at two locations, one upstream of the site, and another downstream of the site (refer to Appendix B for field data sheets).

Table 4-6. Results of water quality testing done at Site NWS01 for the Barnegat Environmental Testing field studies.

Sampling Location	pH	Salinity (o/oo)	D.O. (mg/L)	Specific Conductivity (mS/cm)	Temp (°C)	Turbidity (NTU)
W1 (Cedar Run site, N-most pond; surface)	6.01	0.02	7.52	0.055	14.47	27.3
W2 (Cedar Run site, S-most pond; surface)	5.13	0.03	7.88	0.053	14.47	27.6
W3 (Cedar Run, immed. below site; surface)	4.67	0.02	11.84	0.052	13.81	22.4
W4 (Cedar Run, well below site, bridge at Landing Road; surface)	4.60	0.03	10.11	0.046	13.64	19.3
W4 (Cedar Run, 1 mile upstream of site; surface)	4.95	0.02	9.38	0.050	12.11	26.7

Several items of note were discovered during the water quality data collection in the vicinity of NWS01. The pH of Cedar Run in the site ponds was always acidic, but less so than upstream and downstream of the site, where the pH averaged just under 5.0. The water temperature throughout the stream was cool relative to other streams in the area, averaging about 14 °C below the site, and about 12 °C above the site (and could, therefore, likely be considered a cool water system); flow was also fairly swift. No obvious signs of eutrophication were evident in any of the large ponds on the NWS01 site (refer to NWS01 data sheets, Appendix B).

Physical habitats upstream of the Cedar Run site are of relatively high quality, appear to be well-protected, and are generally well-buffered from roads and development. Upstream of the site, they were rated “optimal” for epifaunal substrate/available cover, pool variability, sediment deposition, channel flow status, channel alteration, bank stability, vegetative protection, and riparian vegetative zone width categories. Downstream of the site, they were rated “optimal” for epifaunal substrate/available cover, pool variability, sediment deposition, channel flow status, channel sinuosity, bank stability, vegetative protection, and riparian vegetative zone width categories. It should

be noted that there was a significant amount of trash and debris in and along the reach of Cedar Run immediately below the Route 9 bridge.

4.8.4 Wildlife

Wildlife and their signs (tracks, scats, calls, and other identifiable physical evidence) observed at and near site NWS01 while conducting the field studies included mallard duck (*Anas platyrhynchos*), black duck (*Anas rubripes*), great blue heron (*Ardea herodias*), Canada goose (*Branta canadensis*), pine warbler (*Dendroica pinus*), great crested flycatcher (*Myiarchus crinitus*), painted turtle (*Chrysemys picta picta*), and white-tailed deer (*Odocoileus virginianus*). None of these animals appeared to be particularly abundant at the site; few of the species were observed more than once despite a number of visits to the site during different seasons.

It should be noted that, despite the presence of a large quantity of open fresh water at the site, few ducks, waterfowl, and other aquatic birds were observed at the Cedar Run site during 5 visits to the site in the fall, winter, spring, and summer months. These results have not been confirmed to date with USFWS or NJDEP Division of Fish and Wildlife.

4.8.5 Environmental Problems at the Site

Loss of Habitat from Hydrological Modifications

The construction of berms and placement of water control structures for cranberry production at the site flooded valuable stream, wetland, and upland habitats and replaced them with relatively sterile open water habitats. A significant amount of Atlantic white cedar wetlands were apparently lost by flooding of the ponds and stream habitats. The water control structures also may serve as barriers to anadromous (herring), catadromous (eel), and resident fish populations on Cedar Run. The open water habitats do not appear to support a significant fishery and there is surprisingly little use by ducks, waterfowl, and other wildlife.

Degradation of Water Quality

Ponded, converted stream habitats such as those at NWS01 likely add to the deterioration of local water quality in Cedar Run, and ultimately in the Bay. This is primarily because they are broad, poorly-flushed environments where dissolved oxygen is lowered, and temperatures and nutrient levels are raised. In addition, the physical habitats of Cedar Run have been altered immediately above and below the site, further exacerbating water quality problems. The natural Atlantic white cedar wetlands that protected water quality and buffered the creek were largely removed and replaced with the large open water ponds as part of the former cranberry bog operation.

4.8.6 Restoration Constraints and Other Site Information

The New Jersey Natural Heritage database indicates that records exist for two plants of concern, curly grass fern (*Schizaea pusilla*) and bog asphodel (*Narthecium americanum*), on or near the NWS01 site. According to these records, curly grass fern was observed on or near the site in 1996; this species is listed by the Pinelands Commission as 'LP' (threatened or endangered); it is not otherwise state or federal-listed, but is apparently rare throughout its natural range. Bog asphodel was identified on or near the site in 1907; this species is a federal candidate for listing, and is listed as state endangered. Because of the age of the record for bog asphodel (nearly 100 years ago) and the fact that it has not been recorded since, it is likely that this species no longer exists at the site. Neither of these species of concern were observed during the site field studies at and in the vicinity of site NWS01. It is not clear at this time how curly grass fern could be affected by the proposed restoration, because its exact existing location on the site (if it exists on and not adjacent to the site) is not known. Further investigations would have to be performed to determine the status of this species at the site. It should be noted that curly grass fern is not a federal or state-listed species; it is listed within the legal jurisdiction of the Pinelands Commission. Not all species currently tracked by the Pinelands Commission are tracked by the NJDEP Heritage Program. A complete list of endangered and threatened pineland species is included in the New Jersey Pinelands Comprehensive Management Plan.

The primary constraint to restoration at the NWS01 site is the fact that a number of wetlands habitats exist within and adjacent to its open water habitats. These habitats are found in the open water (SAV), shrub/scrub, sedge meadow, herbaceous wetlands, and Atlantic white cedar wetlands. It is possible that the extent of these wetlands types could be affected by restoration work at the site.

With regard to anadromous fishery issues, the water chemistry at and upstream of the site has a relatively low pH (below 5.0 in most areas); there has been discussion about how this might affect the potential establishment of the fishery. Almost no historic information exists on the anadromous fishery in the creek. It is likely that further studies would be required, including water quality and gill-netting prior to the initiation of the restoration. It is not known whether alewife are currently present in Cedar Run below the site. From the field studies in this area, the stream water chemistry is not substantially different at and upstream of the site. Further, the physical habitat upstream of NWS01 on Cedar Run appears to be excellent. Further studies on Cedar Run may be necessary to determine whether establishment of an anadromous fishery is possible or likely.

4.8.7 Restoration Concept

The concepts for restoration at NWS01 include establishment of an anadromous fishery in Cedar Run and conversion of the large open water ponds to additional herbaceous wetlands and Atlantic white cedar wetlands. The project would increase vegetated wetlands on the site. Other benefits would likely be realized as part of the

restoration, including freedom of movement for non-anadromous fish and benthos, as well as improved water quality and physical stream habitat.

The existing dilapidated main water control structure immediately north of Route 9 would be removed. Removal of the structure would negate the need for a fish ladder at the site. It is possible that removal of only the water-retention boards part of the structure would achieve this objective. Sections of both berms between the two ponds are already breached (roughly where the original stream channel used to be). After the removal of the boards, the creek would have to be "seeded" by hatchery fish for at least 3 years to establish an anadromous population of alewife.

By removing the water control boards, most of the ponded areas would probably drain, although not completely, because of slight local variations in topography. It is estimated that a significant amount of organic material exists within the existing ponded beds; these will likely act as a "sponge" in retaining water. Conditions would thus be made more conducive for rooted wetland vegetation; areas that are now primarily open water would be converted to densely-vegetated herbaceous wetlands similar to the two types that currently exist at the site. It is also likely that some of the peripheral areas would be converted to Atlantic white cedar wetlands. Other areas would likely convert to mixed deciduous forested wetlands, dominated by red maple and Atlantic white cedar.

To facilitate restoring the existing shrub scrub and Atlantic white cedar wetlands, Atlantic white cedars could be planted in certain areas at appropriate densities. The cedars could be planted as sapling trees with special protective sleeves to lower mortality by herbivores such as white-tailed deer and beaver. From observations made during the field studies at Cedar Run, it is estimated that a total of about 5 acres could be planted with cedars.

4.8.8 Project Implementation

The water-level control boards would have to be gradually removed from the two-sided existing water control structure one side at a time. It would be most prudent to implement this procedure in gradual steps during relatively low flow periods to prevent possible erosion, flooding, and other damage caused by potentially excessive, rapid flow. It is assumed that after removal of the structures, Cedar Run would eventually revert to its historic course and flow patterns. The existing berms would be left in place (both of the main berms are already breached in the approximate area of the historic stream channel). Because the system of existing access roads is adequate, it is likely that any equipment needed to remove the water control boards could be easily brought there. It is possible that the boards could be removed by hand with light power tools such as a winch. The use of best management practices and soil erosion and sediment control techniques would minimize the temporary impacts to Cedar Run during the construction process. It is assumed that the approximately 3-year process of "seeding" alewife fry above the Cedar Run site would be performed by the Division of Fish and Wildlife and that; the costs for this aspect of the restoration would be incurred by the Division.

Assuming that approximately 5 acres of Atlantic white cedar would be restored along the eastern section of the site, and that containerized sapling cedars were planted at a density of approximately 200 per acre, a total of about 1,000 Atlantic white cedar trees would be planted. Under ideal conditions, this quantity of sapling trees could be planted by hand with a crew of 4 persons in a week or less.

Monitoring and maintenance of the restored NWS01 site will require long-term (but not necessarily complex) studies of the anadromous fishery, as well as monitoring of the drained vegetated wetlands habitats to document changes in vegetation at the site. The drained habitats would also have to be monitored at least semi-annually to ensure that invasive plants such as phragmites and purple loosestrife do not become dominant.

4.8.9 Potential Environmental Impacts

Draining large parts of the existing ponded open water areas would change the existing vegetation associations; it would likely result in a net gain in vegetated wetlands. SAV would probably retreat to the stream channel only. Some areas of open water would be converted to herbaceous wetlands or shrub/scrub; other areas would revert to forested Atlantic white cedar wetlands. Such habitats would remain in transition for a number of years; much of it would likely revert to Atlantic white cedar wetlands, the local climax community in these ecological conditions. It is also possible that several ponded "backwater areas" along Cedar Run would remain as open water and support SAV. Because the Atlantic white cedar wetlands most often serve as groundwater discharge areas, it is assumed that the hydrological input would prevent the loss of wetlands at the site after the water control structure is removed. Aerial photographs of the site confirm that Atlantic white cedar wetlands were the historic dominant vegetation prior to construction of the berms and water control structure, and operation of the cranberry bog. Finally, by providing a consistent, dense vegetative cover over the site, effects of downstream flooding would also be lessened.

It is estimated that the existing ponded habitats do not provide exceptional, unique, or rare habitats for wildlife. The shallow, warm water habitats do not present substantial fishery habitats. This is compounded by the fact that the existing water control structure and the berms prevent movement of fish and benthos on and off the site. Passage of anadromous fish to the headwaters of Cedar Run is also prevented. Further, despite a number of visits to the NWS01 site during several seasons, relatively few waterfowl and other aquatic birds were observed using the habitats on the site.

With implementation of appropriate best management practices and soil erosion and sediment control measures, the proposed activities would likely pose minimal impacts on the existing ecological resources. Such measures could include use of silt curtains, hay bales, temporary seeding of steep exposed slopes, etc.

Implementation of the project would not likely result in any additional significant positive or negative impacts relating to air quality and noise levels, water quality, wetlands and other special aquatic areas, finfish (including Essential Fish Habitat)

wildlife resources (including, but not limited to, the target species that have been identified), or threatened and endangered species.

4.8.10 Estimated Costs

The following estimated costs relate to the principal elements of the project implementation at site NWS01, as stated above. The costs listed are approximate only, subject to change, and are primarily intended to provide perspective on the relative magnitude of the project. It should be noted that where a range of costs for each item was available, the maximum cost was used.

Sequential removal of all water control structure boards:
- equipment = $1,500.00
- labor, 120 person-hours @ $35.00 per hour = $4,200.00

Planting of Atlantic white cedar (5 acres):
- 1,000 containerized saplings @ $5.00 each = $5,000.00
- labor, 120 person-hours @ $35.00 per hour = $4,200.00

Monitoring and maintenance:
- Site inspections and monitoring: $800.00 X 6 visits = $4,800.00

GRAND TOTAL = $19,700

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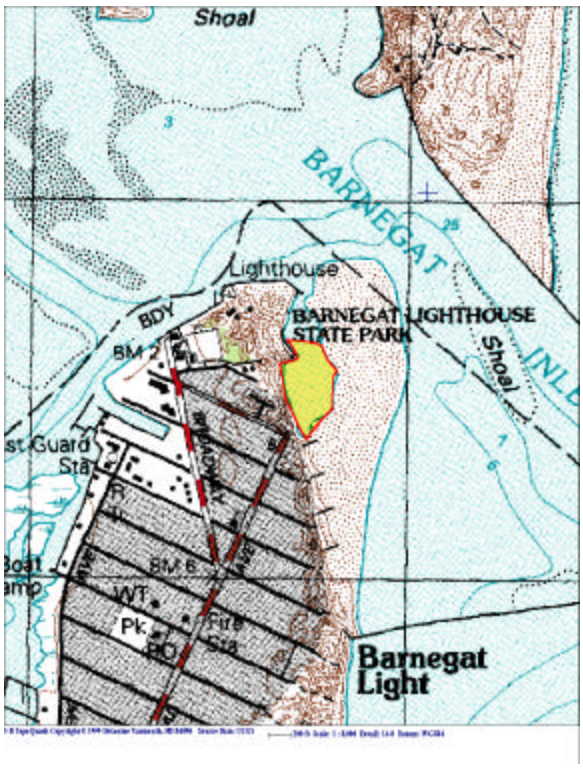
4.9 SITE TWS39 (BARNEGAT LIGHTHOUSE)

4.9.1 Site Description and Ownership

Site TWS39 is owned by NJDEP; it is part of Barnegat Lighthouse State Park. It is located south of Barnegat Inlet, immediately south of Barnegat Lighthouse. To the immediate west and southwest of the site is the town of Barnegat Light; to the east of the site is the Atlantic Ocean. The site, as mapped on Figure 4-9, is a total of 117 acres, including open water. Many physical changes have occurred in the immediate vicinity of the site since the construction of the South Jetty was completed 10 years ago. Dredged sand was spread over parts of the site as part of the South Jetty project. A large pond that previously existed near the northwestern part of the site was filled in; a wet area (in part) dominated by phragmites now exists in its place. The dune system has been gradually accreting in the southern and eastern parts of the site.

The restoration at TWS39 specifically involves improving the existing habitats for piping plover (*Charadrius melodus*), a federal Threatened and state Endangered bird. Because of the specific nature of the restoration project, it was deemed early in the field studies that the substrate corings and other measurements taken at the other restoration sites were not needed for this particular site. In addition to the field studies, several field meetings were made at the site with representatives from NJDEP and USFWS to obtain site-specific information on the history of piping plover there and to discuss restoration options.



NJDEP has made several attempts at improving conditions for piping plover at the site by clearing vegetation in small areas between dunes by disking with a small tractor and disk attachment. Although the attempts have been partially successful (several pairs of piping plovers nest at the site), it was concluded that restoration efforts could be much more successful if an area of shallow, open intertidal water feeding habitat directly adjacent to nesting habitat was provided. Piping plovers also prefer relatively flat sites with little vegetation for nesting, so this element also needed to be incorporated into the restoration.

TWS39A. Obtuse aerial view of the TWS39 site looking southeast from the viewing platform at the top of Barnegat Lighthouse. The South Jetty is to the left of the photo. The photo shows the generally unvegetated state of the northwestern part of the site. Much of the phragmites shows as the light brown and light green area in the middle of the photo. Darker green areas are generally bayberry.

TWS39B. View looking northwest at Barnegat Lighthouse from the northwestern part of TWS39. Note the very sparse vegetation and the lack of dunes in this part of the site. Under the proposed project, excess sand from excavation of a shallow pond would be used to create dunes near here.

TWS39C. View looking east through upland dune community vegetation in the northeastern part of TWS39. Principal species here include American beachgrass, white sweet clover, seaside goldenrod, sand bur, and beach heather.

Finally, because of its location adjacent to Barnegat Lighthouse and the Atlantic Ocean within the state park, parts of the site see a seasonally heavy public use. Many footpaths exist between the public access points and the beach along the southern boundary of the site. This important factor had to be taken into account in developing restoration options at the site.

4.9.2 Vegetation and Land Cover

The primary vegetation type at TWS39 consists of an upland herbaceous dune community. The principal species in the dune community include American beachgrass (*Ammophila breviligulata*), white sweet clover (*Melilotus alba*), seaside goldenrod (*Solidago sempervirens*), sand bur (*Cenchrus tribuloides*), and beach heather (*Hudsonia ericoides*). Phragmites, primarily on uplands, comprises the second largest vegetation type on the site; it exists primarily in a broad north-south band in the western part of the site (areas 2). The phragmites in the parcel is nearly monotypic, but appears relatively weak (it is generally not tall and robust). A small area of the phragmites near the northern part of the parcel (on the jetty side) is likely in wetlands, but this area was not mapped separately from area 2. The only other vegetated areas are small, scattered parcels of bayberry (*Myrica pensylvanica*), primarily in the western part of the site. Vegetation in these parcels is dominated by dense bayberry thickets, but some of the other species from the dune community are also occasionally present.

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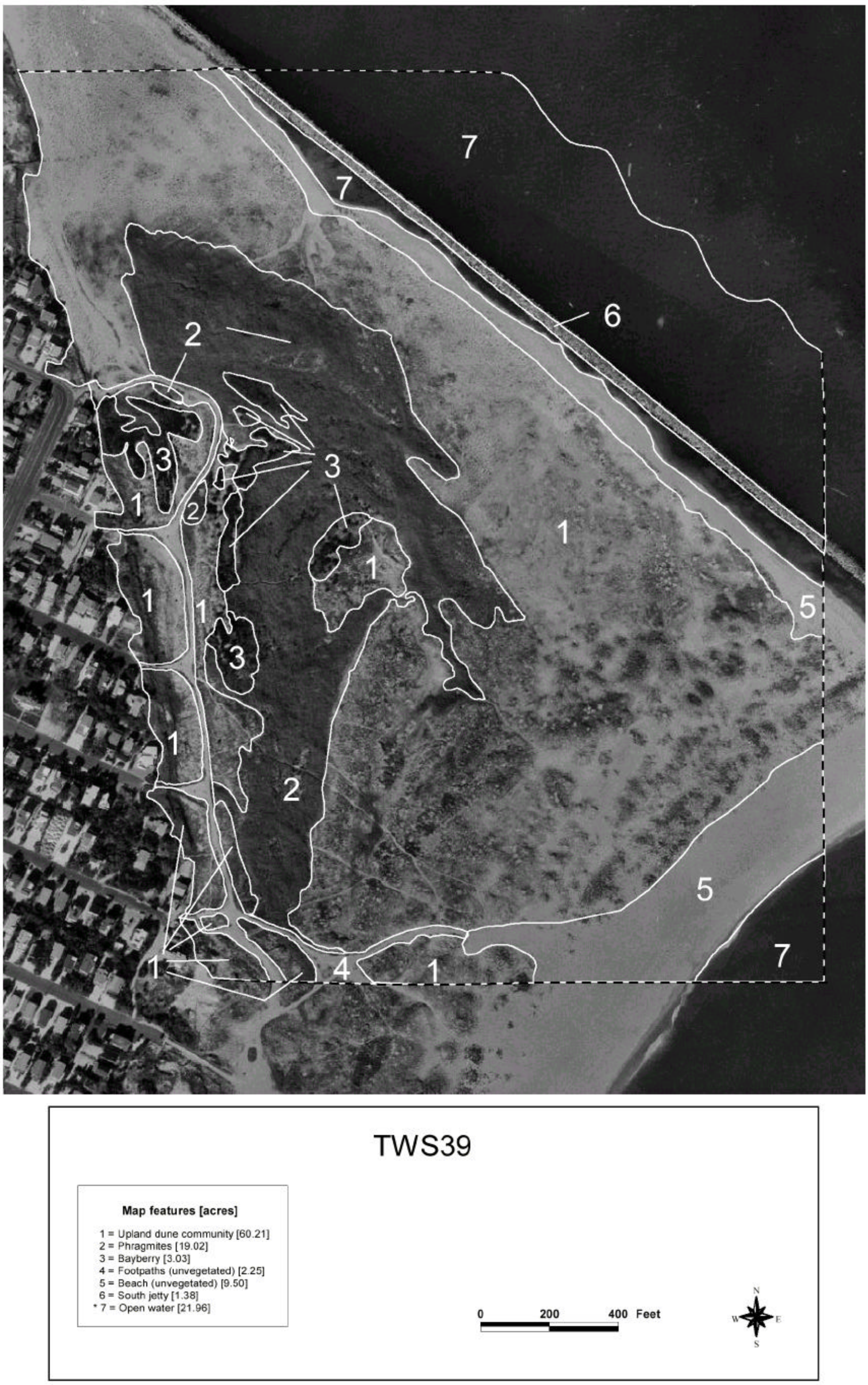

Figure 4-9. Vegetation and land cover of site TWS39. Features were drawn in the field directly onto recent low-altitude, black and white, digitally rectified aerial photographs (USACE 1998). Wetlands vegetation and land cover types are indicated by an asterisk (*) in the legend.

Land cover, such as the open water of the Atlantic Ocean, the open water behind the South Jetty, the unvegetated footpaths, and the South Jetty itself were included as part of the site; they will all be important elements in the restoration. The densely-populated city of Barnegat Light is located to the immediate west and southwest of the site.

4.9.3 Water Quality

Surface water quality was not measured at site TWS39 during the field visits, as it was deemed not to be necessary for design and planning of the restoration.

4.9.4 Wildlife

Wildlife and their signs (tracks, scats, calls, and other identifiable physical evidence) observed at and near site TWS39 while conducting the field studies and the agency site meetings were all birds. These included piping plover (*Charadrius melodius*), semipalmated plover (*Charadrius semipalmatus*), sanderling (*Calidris alba*), least sandpiper (*Calidris minutilla*), spotted sandpiper (*Actitus macularia*), laughing gull (*Larus atricilla*), greater black-backed gull (*Larus marinus*), herring gull (*Larus argentatus*), common tern (*Sterna hirundo*), Forster's tern (*Sterna fosteri*), and osprey (*Pandion haliaetus*). Most of the birds were observed flying or feeding near the open water along the South Jetty and the beach in the southern part of the site. Two adult piping plovers were observed in the southern part of the site in the dune area near the beach. The piping plovers observed had recently fledged young several weeks before, and were likely temporarily remaining at the site (personal communication, D. Jenkins, NJDEP). It should be noted that a large part of the southern area of the site is fenced off from the public and is posted as piping plover breeding habitat. NJDEP erects and takes down the semi-permanent fence every year (i.e., the fence is taken down after conclusion of piping plover breeding season) through a local volunteer effort.

4.9.5 Environmental Problems at the Site

Loss of Habitat from Dredging and Filling

Dredged sandy materials were placed on the site during construction of the South Jetty. A large, apparently natural pond was filled in, in part because of potential safety and health concerns. Some areas of dune were lost as a result of the placement of the materials. Construction of the jetty has apparently resulted, however, in strong accretion of new dunes and building of the existing dunes. These areas have been allowed to vegetate, however, resulting in inadequate habitat for piping plovers.

Dominance by Phragmites

A large part of the site (about 19 acres total) is currently dominated by phragmites. The phragmites apparently got started in the wettest area of the former pond (after it was filled) and spread to the south from there. It is uncertain at this time whether the phragmites will spread further through other areas of the site. It is unlikely that it will colonize the high dunes because of the existing vegetation and the dryness in these areas.

The saltwater pond proposed as part of this restoration would eliminate part of the existing phragmites, part of it directly from pond construction, and part from exposure to the saline tide. It has been demonstrated that phragmites can be easily and thoroughly killed when exposed to regular tidal flooding by waters with a salinity of at least 18 parts per thousand (Barrett and Niering 1993).

4.9.6 Restoration Constraints and Other Site Information

The New Jersey Natural Heritage database indicates that records exist for piping plover (*Charadrius melodus*) and least tern (*Sterna antillarum*) in the vicinity of the TWS39 site. All of the location information for both species indicates a much larger area than that of the TWS39 site. The single record for piping plover is from June, 1996. The three records for least tern are from summer of 1996, summer of 1986, and 1983 (no season given). Piping plovers are listed as federal Threatened and state Endangered. They are considered to be somewhat rare throughout their natural range, and their breeding populations are considered critically imperiled in New Jersey. Least terns are state listed as Endangered; they are apparently secure throughout their natural range, but breeding populations are considered critically imperiled in New Jersey. Heritage records for both of these species at this site are not surprising; piping plover was observed at the site during the field studies, and has been intensively studied. Least terns are also regularly observed at the site (personal communication, David Jenkins, NJDEP). The proposed restoration project at TWS39 is expected to have a significant positive effect on the breeding population of piping plovers at the site. Because they utilize similar (but not identical) habitats, the proposed restoration may also have a significant positive effect on least tern.

The TWS39 site is part of an area designated by NJDEP Heritage as the Barnegat Light Macrosite, a Natural Heritage Priority Site. According to Heritage, the macrosite contains a coastal barrier beach at the northern portion of Long Beach Island, including a dredged material disposal island and a newly formed sandy area created by the deposition and accretion of sand along the new jetty. The boundaries were drawn to include beaches and dunes that are critical habitats for a number of state listed birds.

The principal constraint for restoration of the TWS39 site will be the public element. The site is highly public; it is not only within state park lands, but is also directly adjacent to a densely-developed area. Footpaths exist from the main beach access points to a main footpath along the western edge of the site. Additional footpaths branch off of the main path and meander through the site (particularly in the southwestern part). These footpaths are heavily traveled in-season by beach-users. Because the proposed restoration would require fencing for protection against pedestrians and predators, it would be most appropriate to create the new site within the area that is already fenced annually for piping plovers (i.e., no new fencing would be required).

The restoration site would be highly visible to local residents within the Barnegat Light community. It is estimated, however, that the site would not be aesthetically objectionable, as it will consist only of one small, very shallow pond (plover intertidal

feeding area) and an adjacent small area essentially cleared of most of its vegetation (plover breeding area). The on-site vegetation would be cleared by infrequent disking (not herbicides). Long-term permitting by NJDEP/LURP for the vegetation clearing is not certain at this time, and is currently under discussion. The tidal pond would be constructed so that it would be less than 3 feet deep, and flushed by every tidal cycle. These conditions would provide maximum feeding opportunities for the piping plovers, and would minimize the possibility for mosquito breeding. It is concluded that the restoration could be created and maintained with no change in the current (human) uses of the site.

4.9.7 Restoration Concept

It is the opinion of avian biologists that the availability of shallow intertidal habitats directly adjacent to piping plover breeding areas is a critical factor to the success of a site (personal communication, D. Jenkins, NJDEP). Piping plovers currently nesting at the TWS39 site frequent the intertidal area behind the South Jetty for feeding, a distance of roughly 300 to 400 feet. Further, humans walk the narrow area of beach landward of the jetty, and probably disturb the feeding plovers. Following these observations, the restoration would provide an approximately 3.5-acre, shallow, intertidal pond for piping plover feeding that is immediately adjacent to a newly-cleared breeding site. The pond would be flushed with every tidal cycle, and would provide maximum feeding opportunities for piping plovers. A simple, wide, relatively shallow ditch would feed the pond; no water control structures would be required. The banks of the ditch would be heavily vegetated up to the entrance of the pond, to assist in slowing erosion. A small pedestrian footbridge and viewing platform could be built to provide access over the ditch. The ditch would be designed for relatively easy maintenance by very small equipment (e.g., bobcat or small bulldozer).

Both the breeding area and the pond portions of the site are within a relatively flat area that was cleared of vegetation by disking several years ago. The pond and ditch would be excavated from this area, and the adjacent breeding habitat would be cleared of vegetation by disking.

It would be preferable to dispose of excavated materials on the site (as opposed to barging or trucking it elsewhere). Materials taken from the excavated channel and pond could be deposited on the northern part of the site to build dunes where they are currently nonexistent (in the area immediately north of the current area of phragmites). This action would provide the added benefit of initiating dune development and would help to stabilize the area. There is currently no information, however, regarding whether there would be public support or opposition to this aspect of the proposed project.

4.9.8 Project Implementation

The 3.5-acre pond would be graded with small equipment (a small bulldozer could be used effectively) so that it will vary between several inches to a maximum of 3 feet in depth, with an average overall depth of about 18 inches at mean high tide (detailed

engineering studies will have to be performed to determine the exact amount of grading to achieve these goals). The channel would then be cut to connect the pond with the water behind the jetty. The channel would be approximately 200 feet long and a maximum of 100 feet wide and relatively straight. Detailed engineering studies must be performed to determine the ideal depth for the channel, but it is estimated that it would be approximately 28 inches deep. Beachgrass and other vegetation would be planted along the immediate banks of the channel to slow erosion (disposal site selection would be made with approval of and permitting from NJDEP/LURP). All excavated materials would be deposited in the northern part of the site for dune creation. A small wooden pedestrian footbridge could be constructed for fording the channel at high tide.

Monitoring and maintenance of the site will involve a semi-annual inspection in conjunction with NJDEP over at least three consecutive years to monitor the success of piping plover nesting at the site, and to ensure that proper flushing of the pond by the tides is achieved. Other problems specific to the success of piping plover nesting at the site shall be identified and rectified as early as possible. It is anticipated that project success will be evident within two breeding seasons (i.e., two years) (personal communication, David Jenkins, NJDEP).

4.9.9 Potential Environmental Impacts

Owing in part to the relative simplicity of the proposed project and its context, relatively few environmental impacts are envisioned. The site is part of a very dynamic system that changes regularly with storms, tides, and other natural events. In this context, the proposed work is relatively small. The project would provide critical feeding and breeding habitat for a federal threatened/state endangered species, and would have the added benefits of a small amount of phragmites elimination, dune creation, and a public amenity (footbridge/viewing platform).

Implementation of the project would not likely result in any additional significant positive or negative impacts relating to air quality and noise levels, water quality, wetlands and other special aquatic areas, finfish, including Essential Fish Habitat, wildlife resources including, but not limited to, the target species that have been identified, and threatened and endangered species.

4.9.10 Estimated Costs

The following approximate estimated costs relate to the principal elements of the project implementation at site TWS39, as stated above. The costs listed are approximate only, subject to change, and are primarily intended to provide perspective of the relative magnitude of the project. It must also be noted that where a range of costs for each item was available, the maximum cost was used.

Channel cutting/sandy material disposal on north part of site:
1,704 cubic yards @ $35.00 per c.y. = $59,640

Pond excavation/sandy material disposal on north part of site:
8,470 cubic yards @ $35.00 per c.y. = $296,450

Vegetation clearing/disking:
$500 per day X 1 day = $500.00

Footbridge construction:
materials = $3,000
labor = $2,000

Monitoring and maintenance:
Site inspections/plover monitoring: $800.00 X 6 visits = $4,800.00

GRAND TOTAL = $366,390

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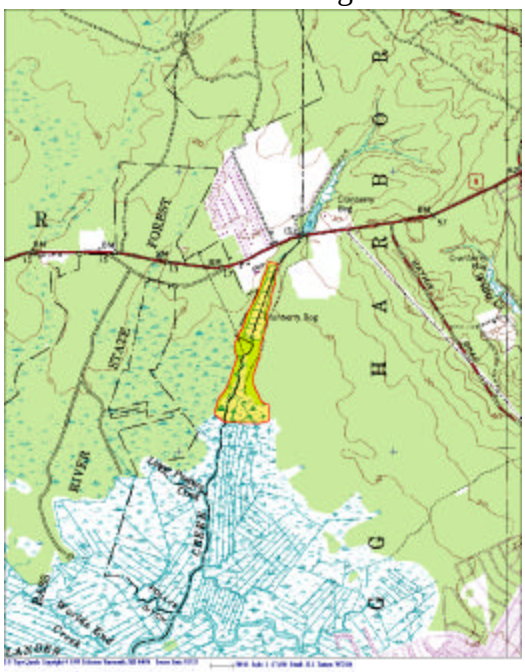
4.10 SITE TWS02 (BALLANGER CREEK ABANDONED CRANBERRY BOG)

4.10.1 Site Description and Ownership

Site TWS02 is owned by the NJDEP and is within a large area designated as the Ballanger Creek Natural Heritage Priority Site by NJDEP. Through its Natural Heritage Database, NJDEP Office of Natural Lands Management (ONLM), the Natural Heritage Priority Sites have been identified as critically important areas to conserve New Jersey's biological diversity. The TWS02 site is located about 2 miles southwest of Tuckerton, on the south side of Route 9. The ONLM does not currently possess records of listed species on the TWS02 site itself (several are listed in the immediate vicinity of Lake Pohatcong; approximately 3 miles to the northeast of TWS02). The Ballanger Creek site is a former cranberry bog, now owned and managed by NJDEP; the site as mapped is a total of about 22 acres. The TWS02 site essentially consists of two large and one small ponded areas (all partially vegetated) on Ballanger Creek, surrounded on their peripheries by herbaceous marsh, shrub/scrub, and upland forest. The ponded areas were created by construction of three short, sandy berms on Ballanger Creek. Ballanger Creek is tidal (freshwater) up to the southern end of the site. A large abandoned blueberry field was also discovered to the immediate east of the upper third of the site (the shrubs were large and were still bearing fruit).



From the large number of dead cedar trees that currently exist in and around the two large open water areas, it is surmised that the bog operation was abandoned a number of years ago (leading to physical changes at the site). The lower two berms subsequently went into disrepair, and the cranberry bog ponds drained. With the drained conditions, Atlantic white cedar trees were able to colonize the site. At a later point in time, beavers then moved onto the site and patched the berm breaches. The ponds then were re-flooded, killing the cedars (Atlantic white cedar will not survive in constant, deep, standing water). Both of the berms at the two lower ponds still possess partially-breached beaver dams (essentially all that is holding the water in place).

TWS02A. Detail showing partially-breached section of lowest (southern-most) berm at TWS02 where beavers had patched it, in the southeastern part of the site. The small breach allows only a minimal outflow to Ballanger Creek from the site; the pond level is relatively deep near the berm. This beaver-patched section of the berm is only about 8 feet long and 3 feet above pond level.

TWS02B. View looking northwest at the former cranberry bog pond from the lowest berm. Note the numerous dead Atlantic white cedar trees (likely an artifact from a period when the pond was thoroughly breached and drained) throughout the pond.

TWS02C. View looking northwest from area 2 in the northeastern part of the lower ponded area at TWS02. Note the many standing dead Atlantic white cedar trees and the three species of sundews (spatulate-leaved, thread leaved, and round leaved) that are red-orange in color. This location possesses deep, organic substrate.

The main berms and roads separating the ponds were measured and the water control structure was measured and characterized during the fieldwork. The lowest (main) berm averages 20 feet wide by 3 feet above pond level and is 400 feet long; the partially-breached beaver dam portion is 8 feet wide. The middle berm averages 17 feet wide by 3 feet above pond level and is 400 feet long; the fully-breached beaver dam portion is 15 feet wide. The upper berm averages 17 feet wide by 3 feet above pond level and is 200 feet long; it is currently intact (i.e., not breached). The pond level at the lower berm is approximately 28 inches above Ballanger Creek at high tide. Several soils borings were made in the wet terrestrial areas (i.e., herbaceous marsh) of the two lower ponds. Deep black organic soils, at least 4 feet in depth exist in this area. Refer to Appendix B for the field data sheets for site TWS02.

4.10.2 Vegetation and Land Cover

The primary wetland vegetation and land cover in the southern third of TWS02 is a combined type, consisting of open water, dead Atlantic white cedars, and herbaceous marsh (areas 1; Figure 4-10). The lowest (southern-most) pond possesses a greater quantity of open water and less herbaceous marsh than the middle pond. The lower pond is an average of about 2.5 to 3 feet in depth, and possesses some SAV (primarily fragrant water lily, *Nymphaea odorata*). Nearly the entire middle pond area is composed of herbaceous marsh. Open water is confined essentially to the narrow stream channel in the center of the middle pond parcel. Predominant species in herbaceous marsh areas on TWS02 include spatulate leaved sundew

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TWS02

Map features [acres]

* 1 = Open water/Dead cedars/Herbaceous marsh [4.63]
* 2 = Herbaceous marsh/Dead cedars [3.61]
* 3 = Narrow-leaved cattails [0.16]
* 4 = Wetland deciduous forest [2.73]
* 5 = Phragmites (tidal) [0.64]
* 6 = Shrub/scrub (Highbush blueberry/Clethra) [1.18]
7 = Upland deciduous forest [6.95]
* 8 = Shrub/scrub (Alder/Carex) [0.52]
* 9 = Phragmites (non-tidal) [0.79]
10 = Berms [0.44]

0 200 400 Feet

N W E S

Figure 4-10. Vegetation and land cover of site TWS02. Features were drawn in the field directly onto recent low-altitude, black and white, digitally rectified aerial photographs (USACE 1998). Wetlands vegetation and land cover types are indicated by an asterisk (*) in the legend.

(*Drosera intermedia*), thread leaved sundew (*Drosera filiformis*), round leaved sundew (*Drosera rotundifolia*), soft rush (*Juncus effusus*), and dwarf St. Johns wort (*Hypericum mutilum*). Several grass and sedge species were also present but were not identifiable, owing to the early season field studies. Interestingly, very few large cranberry (*Vaccinium macrocarpon*) plants were observed anywhere at the site. The small, northern-most pond at the site is primarily open water, but possesses very narrow areas of herbaceous marsh on all sides. It also possesses scattered dead cedar trees along its eastern and northern sides. A long, narrow parcel of herbaceous marsh with no open water (area 2) exists along the east side of the lower pond areas.

A long, very narrow parcel of wetland shrub/scrub (area 6) exists on the west side of the two lower pond areas. The shrub/scrub is composed primarily of dense shrubs with scattered small trees along the edge of the ponds. The principal species in the shrub/scrub include highbush blueberry (*Vaccinium corymbosum*) and sweet pepperbush (*Clethra alnifolia*); buttonbush (*Cephalanthus occidentalis*) and speckled alder (*Alnus rugosa*) were also occasionally present. Scattered small trees in the shrub/scrub include red maple (*Acer rubrum*) and black gum (*Nyssa sylvatica*). Few herbaceous plants were present in the shrub/scrub.

Immediately below the lower pond is a parcel of wetland deciduous forest (area 4). The forest is relatively open-canopied and is composed of medium-sized trees with moderately dense shrub and herbaceous layers. The principal tree species in the wetland forest are red maple (*Acer rubrum*) and black gum (*Nyssa sylvatica*); Atlantic white cedar (*Chamaecyparis thyoides*) and sweet bay (*Magnolia virginiana*) were also occasionally present. Trees here average about 6 to 8 inches diameter at breast height, although several larger cedar trees were present. Shrubs in the forest include highbush blueberry, speckled alder, and sweet pepperbush. Herbaceous plants in the wetland forest include cinnamon fern (*Osmunda cinnamomea*), royal fern (*Osmunda regalis*), and several species of grasses and sedges that were not identifiable owing to the early season field studies.

A small parcel of alder-dominated shrub/scrub exists immediately southwest of the northern-most berm, around the outfall from the small northern pond (area 8). The shrub/scrub is dominated by a dense thicket of speckled alder (*Alnus rugosa*); buttonbush was also present. It also possesses a locally-dense herbaceous understory of sallow sedge (*Carex lurida*), fringed sedge (*Carex crinita*), bristly sedge (*Carex comosa*), and common rush (*Juncus effusus*).

The tidal herbaceous wetlands along Ballanger Creek below the lower pond include narrow-leaved cattails (*Typha angustifolia*; area 3) and phragmites (*Phragmites australis*; area 5). The narrow leaved cattails exist on the right bank of the creek, and also contain some phragmites. The phragmites exists on the left bank of the creek; it is composed solely of a dense, monotypic growth of phragmites. These long narrow areas exist along the creek for about 800 to 1,000 feet below the site before they grade to spartina marsh.

Upland deciduous forest (areas 7) exists in two separate parcels in the northern part of the site. The upland forest possesses primarily small trees and is open-canopied, with moderately dense shrub/woody vine and herbaceous layers. The eastern forest parcel is dominated by red maple (*Acer rubrum*), Norway maple (*Acer platanoides*), sweetgum (*Liquidambar styraciflua*), and tulip poplar (*Liriodendron tulipifera*). The shrub and woody vine layer is dominated by poison ivy (*Toxicodendron radicans*), sweet pepperbush (*Clethra alnifolia*), and spicebush

(*Lindera benzoin*). A large portion of the eastern forested parcel contains a former domestic dump site, containing many bottles, cans, and old refuse. The narrow western forest parcel possesses most of the same principal species, but also contains both black willow (*Salix nigra*) and crack willow (*Salix fragilis*) along its eastern sides where it borders a wet area of phragmites.

It should also be noted that a large, open-water pond on Ballanger Creek also exists off the site immediately north of Route 9. This pond was also apparently part of a former cranberry bog operation. It is largely unvegetated, but possesses SAV. Surface water quality was measured in this pond (see Water Quality, below).

4.10.3 Water Quality

Surface water quality was measured at four locations on the TWS02 site and within the near watershed (Table 4-7; refer to Section 1 for a description of the equipment used). In addition, a physical stream habitat assessment was conducted at one location, downstream of the site (refer to Appendix B for field data sheets). It should be noted that there is currently no apparent direct connection between the off-site pond immediately north of Route 9 and Ballanger Creek (the small upper pond) on the site. The outfall from the off-site pond ends at a near vertical series of rock-filled gabions in the right-of-way for Route 9. Despite searches on the road rights-of-way on both the north and south sides of Route 9, no pipe or culvert was located. The creek, therefore, apparently begins on the northern-most part of the TWS02 site in a small, extremely turbid, sediment-filled stormwater pond and drains to the south. At the opposite (southern-most) end of the site, Ballanger Creek is freshwater tidal up to the lower berm; it appears to possess a tidal range of approximately 20 inches immediately below the site.

Table 4-7. Results of water quality testing done at Site TWS02 for the Barnegat Environmental Testing field studies.

Sampling Location	pH	Salinity (o/oo)	D.O. (mg/L)	Specific Conductivity (mS/cm)	Temp (°C)	Turbidity (NTU)
W1 (site, lower pond; surface)	5.02	0.03	3.45	0.059	14.30	18.3
W2 (creek immed. below site, tidal; surface)	5.44	0.15	8.58	0.039	14.42	22.1
W3 (off-site pond, N of Rt. 9; surface)	5.67	0.09	1.54	0.195	14.43	105.5
W4 (creek, N-most part of site; surface)	4.56	0.03	5.77	0.066	16.16	21.7

Several items of note were discovered during the water quality data collection in the vicinity of TWS02. The pH of Ballanger Creek in the site ponds and above and below the site was always acidic, with a pH averaging about 5.0. The salinity of the creek was low, even immediately below the site, where there was a tidal range of about 20 inches. The dissolved oxygen content was low in the site lower pond, at about 3.5 mg/L; the off-site pond to the north was even lower, at only about 1.5 mg/L (refer to TWS02 data sheets, Appendix B).

Physical habitats downstream of Ballanger Creek are of moderate to marginal quality. The stream rated "optimal" for three parameters, including sediment deposition, channel flow status, channel alteration, and riparian vegetative zone width; it rated "marginal" in all other classification categories. Some evidence of channelization was present, but the creek presented at least moderate-quality habitat that is typical of many tidal streams in the region, and is well-buffered.

4.10.4 Wildlife

Wildlife and their signs (tracks, scats, calls, and other identifiable physical evidence) observed at and near site TWS02 while conducting the field studies included great crested flycatcher (*Myiarchus crinitus*), acadian flycatcher (*Empidonax virescens*), blue-gray gnatcatcher (*Polioptila caerulea*), rough-winged swallow (*Stelgidopteryx ruficollis*), tree swallow (*Iridoprocne bicolor*), house wren (*Troglodytes aedon*), ovenbird (*Seiurus aurocapillus*), northern water snake (*Nerodia sipedon sipedon*), northern leopard frog (*Rana pipiens*) and bullfrog (*Rana* sp.). All of the birds listed were heard or observed in the vicinity of the two lower pond areas on the site, primarily along the edges. Several bird species, such as acadian flycatcher and ovenbird, were calling from areas of upland forest immediately off-site to the west. The water snake, approximately 3 feet in length, was observed in the creek immediately below the lowest berm. Several leopard frogs and bullfrogs were observed in the small uppermost pond.

It should be noted that, despite the presence of a moderate quantity of open fresh water at the site, there is an apparent lack of use by ducks, waterfowl, and aquatic birds in general at the Ballanger Creek site; this was confirmed during three visits to the site in the fall, winter, and spring months during 1999 and 2000. Also notable is the restoration concept that all of the dead cedar snags would be left standing for wildlife amenities (nesting and resting/roosting/loafing perches) after implementation of the project.

4.10.5 Environmental Problems at the Site

Loss of Habitat from Hydrological Modifications

The construction of berms and placement of water control structures for cranberry production at the site flooded valuable stream, wetland, and upland habitats and replaced them with relatively sterile open water habitats. A significant amount of Atlantic white cedar wetlands were apparently lost by flooding of the ponds and stream habitats. The open water habitats apparently provide a very poor fishery and are also apparently surprisingly little-used by ducks, waterfowl, and other wildlife.

Degradation of Water Quality

Ponded, converted stream habitats such as those at TWS02 likely add to the deterioration of local water quality in Ballanger Creek, and ultimately in the Bay. This is primarily because they are broad, poorly-flushed environments where dissolved oxygen is lowered, and

temperatures and nutrient levels are raised. In addition, the physical habitats of Ballanger Creek have been altered immediately above and below the site, further exacerbating water quality problems. The natural Atlantic white cedar wetlands that protected water quality and buffered the creek were largely removed and replaced with the large open water ponds as part of the former cranberry bog operation.

4.10.6 Restoration Constraints and Other Site Information

The New Jersey Natural Heritage database indicates that records exist for one plant, marsh rattlesnake master (*Eryngium aquaticum*), on or near the TWS02 site. According to these records, rattlesnake master was observed on or near the site in 1985. This species is not federal or state listed (i.e., listed as a protected plant under either the Federal Endangered Species Act or New Jersey regulations. State rankings indicate relative abundance of the plant in the state, as compared to the rest of its natural range.), but has been assigned a state ranking, indicating that it is relatively rare in the state. It is apparently secure throughout the rest of its natural range. This species was not observed at the Ballanger Creek site during the Barnegat field studies. Marsh rattlesnake master is a plant of marshes and bogs, but it is not clear at this time how it could be affected by the proposed restoration, as its exact location(s) are not currently known.

The primary constraint with the TWS02 site relates to the fact that a number of wetlands habitats exist within and adjacent to its open water habitats. These habitats are found in the open water (SAV), shrub/scrub, sedge meadow, herbaceous wetlands, and Atlantic white cedar wetlands. The possibility exists that these wetlands habitats could be affected by restoration work at the site. It is most likely, however, that existing open water habitats would be converted to vegetated wetlands (herbaceous, shrub/scrub, Atlantic white cedar) with the proposed restoration work, and there would be a net gain in vegetated site wetlands. No rare, threatened, or endangered (RTE) species have been identified at or directly adjacent to the TWS02 site to date.

4.10.7 Restoration Concept

The concept for restoration at TWS02 involves removal of the beaver dam portion (approximately 8-foot section) of the berm on the lowest pond. Removal of this water blockage would likely drain enough of the standing water in the lower and middle ponds to allow the natural wetlands communities to become re-established in this part of the site. These vegetated wetlands communities include types already existing on and adjacent to the site, including herbaceous marsh and Atlantic white cedar wetlands. It is clearly evident that the site was previously drained by berm blowouts, when Atlantic white cedar and other wetland vegetation were enabled by the new physical conditions (i.e., little or no standing water) to re-colonize. These vegetated areas then died back after the beavers re-flooded the site. After draining of the site, it would be allowed to re-vegetate naturally, but beavers would have to be denied access, possibly through use of exclusion devices or pest management. The site would also have to be inspected at least several times a year to ensure that problem invasive species, such as phragmites and purple loosestrife do not become dominant.

Because Ballanger Creek apparently does not continue north above Route 9, it is not likely that this site would provide valuable habitat for anadromous fish.

4.10.8 Project Implementation

The proposed beaver structure removal work could be implemented by hand with a crew of 3 or 4 persons using hand tools and possibly minor explosives. The beaver structure consists of a combination of logs, sticks, mud, and other materials. Because the beaver structure would be gradually removed, and because there are no residents, roads, or other public flood-related elements downstream of the site, concern for flooding, including flooding of vegetation, should be minimal. Further, the creek is well-vegetated below the site; it is not likely that the creek banks below the site would be adversely affected. It is presumed that the creek would reach equilibrium with the new flow regime relatively quickly.

Access to the beaver structure on foot with hand tools would be relatively easy, over the existing system of paths. Some branch-trimming and pothole-filling would have to be performed along the main upland dirt road along the western side of the site to improve access by small truck. Such temporary access improvements would pose little ecological impact.

Monitoring and maintenance of the restored TWS02 site will require at least semi-annual inspections to monitor the drained vegetated wetlands habitats and to document changes in vegetation at the site. The site would have to be inspected for the presence of beavers; new beaver dams would have to be removed immediately. The drained habitats would also have to be monitored at least semi-annually to ensure that invasive plants such as phragmites and purple loosestrife do not become dominant.

4.10.9 Potential Environmental Impacts

Draining of most of the existing ponded open water areas in the lower two ponds would change the existing vegetation associations; it would likely result in a net gain in vegetated wetlands. SAV would probably revert to within the stream channel only. Some areas of open water would be converted to herbaceous wetlands or shrub/scrub; other areas would revert to forested Atlantic white cedar wetlands. Such habitats would remain in flux for a number of years; much of it would likely revert to Atlantic white cedar wetlands, the climax community in this area in these ecological conditions.

Deep, organic substrates are present throughout the ponded areas of the site. It is likely that these areas would continue to maintain the wetness provided to the area by both Ballanger Creek and groundwater discharge after the restoration is completed. The fact that wetland vegetation can establish after berm-breaching (pond draining) has been virtually demonstrated (i.e., dead cedars and partially flooded areas of herbaceous marsh) at the site.

It is estimated that the existing ponded habitats do not provide exceptional, unique, or rare habitats for wildlife. The shallow, warm water, low dissolved oxygen habitats do not likely present excellent fishery habitats. Further, despite a number of visits to the TWS02 site during

several seasons, relatively few waterfowl and other aquatic birds were observed using the habitats on the site.

With implementation of appropriate best management practices and soil erosion and sediment control measures, the proposed activities would likely pose minimal impacts on the existing ecological resources. Such measures could include use of silt curtains, hay bales, temporary seeding of steep exposed slopes, etc.

Implementation of the project would not likely result in any additional significant positive or negative impacts relating to air quality and noise levels, water quality, wetlands and other special aquatic areas, finfish, including Essential Fish Habitat, wildlife resources including, but not limited to, the target species that have been identified, and threatened and endangered species.

4.10.10 Estimated Costs

The following approximate estimated costs relate to the principal elements of the project implementation at site TWS02, as stated above. The costs listed are approximate only, subject to change, and are primarily intended to provide perspective of the relative magnitude of the project. It must also be noted that where a range of costs for each item was available, the maximum cost was used.

Removal of 8-foot beaver dam section of lower berm:
equipment = $1,000.00
labor, 120 person-hours @ $35.00 per hour = $4,200.00

Monitoring and maintenance:
Site inspections and monitoring: $800.00 X 6 visits = $4,800.00

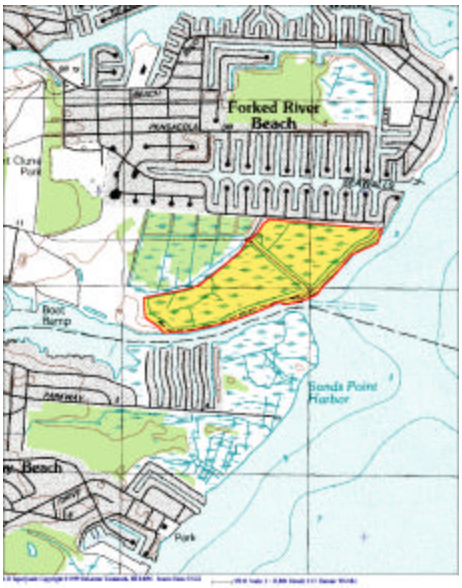
GRAND TOTAL = $10,000

4.11 SITE TWC21 (OYSTER CREEK)

4.11.1 Site Description and Ownership

Site TWC21 is owned by GPU Energy of New Jersey. It is located on the left bank of Oyster Creek at its confluence with Barnegat Bay. TWC21 is shaped like a long, curved rectangle (longer east to west than north to south), and is a total of approximately 111 acres. The site is composed of three large sections that are divided by a series of berms and ditches. The ditch systems in the eastern and central sections flow along their peripheries and are substantial (in places the ditches are nearly 20 feet wide); these were presumably created to drain the dredged materials after deposition on the site. The ditches are isolated and are not connected to the tide. The site has been used for the disposal of dredged material within the past 20 years. This site is closest to existing residences (Forked River Beach lagoon community) on the northern end of its eastern-most parcel, where the end of the site meets Orlando Drive.

Substrate corings and other measurements were taken in many areas of the site during the field studies. The highest area of the site is in area 5, in the western-most section of the site (area 5, Figure 4-11); this area is approximately 8 to 10 feet above mean high water in Oyster Creek, and is composed of medium to coarse sand. The adjacent areas 3 and area 6 are slightly lower, about 5 to 6 feet above mean high water in the creek (no groundwater was intercepted in these areas). The western-most parcel of area 1 is 2.5 to 3 feet above the creek and possesses medium sand with a few cobbles; groundwater is about 1 inch from the surface. The large central section of the site (area 1; possessing a dense cover of phragmites; see Vegetation and Land Cover, below) is about 2 feet above mean high water in the creek and possesses a coarse sand and cobble substrate. Groundwater was intercepted at about 1 inch from the surface throughout this area. The large eastern-most parcel of the site (also possessing a dense cover of phragmites) is generally the lowest and wettest part of the site overall. Much of this area appears to be about 1 foot or less above mean high water of the creek; the substrate consists of medium sand with a few cobbles. Several small, shallow, stagnant ponds exist within this area; some are isolated, and some connect to the peripheral ditch system (the depth of the ponds could not be determined owing to soft, deep substrate and potentially hazardous conditions).



TWC21A. View looking northwest from large open sandy area (area 5) in the western part of TWC21. Beach heather is the low-growing plant in the mid-ground of the photo; switchgrass is in the foreground. The small trees at the edge of the sandy area are part of area 3.

TWC21B. View looking northwest into a large area of phragmites from the small parcel of area 6 in the southcentral part of the site.

TWC21C. View looking southeast from the southcentral part of TWC21, at the bulkheaded, re-enforced shoreline near the mouth of Oyster Creek (see area 6, Figure 4-11).

4.11.2 Vegetation and Land Cover

The primary vegetation type at TWC21, particularly in the eastern and central sections of the site, is phragmites marsh. The entire eastern two-thirds of the site is almost wholly composed of phragmites marsh, small stagnant shallow ponds, and large ditches, with two minor exceptions. Three narrow berm areas near the southcentral and southeastern parts of the central section of the site and along the southern (creek) end of the western section (areas 6), and a small area in the northwestern-most part of the eastern section (area 4) possess shrub-scrub vegetation. Areas 6 are dominated by switchgrass (*Panicum virgatum*) and broomsedge (*Andropogon virginicus*); scattered bayberry (*Myrica pensylvanica*) and small red maple (*Acer rubrum*) trees are also present along its margins with the lower areas (i.e., where it meets phragmites or open water). Area 4 is dominated by phragmites on its eastern side; on its western side it possesses a mixture of small red maple, black gum (*Nyssa sylvatica*), black cherry (*Prunus serotina*), sassafras (*Sassafras albidum*), and persimmon (*Diospyros virginiana*) trees, highbush blueberry, switchgrass, and phragmites. The trees on the northwestern side of area 4 were the largest (6 to 8 inches dbh maximum) and most dense (although not sufficiently dense to be considered "forest"). Another scrub-shrub vegetation type that is partly dominated by phragmites exists within areas 3. Principal species in these areas are phragmites, highbush blueberry (*Vaccinium corymbosum*), red maple, and switchgrass. One of the most interesting areas of the site is the open, sandy habitat within area 5, dominated by beach heather (*Hudsonia tomentosa*). The beach heather is densest in the northwestern part of the area; other places in the area are composed of a mixture of open sand and scattered clusters of switchgrass and broomsedge. The

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Figure 4-11. Vegetation and land cover of site TWC21. Features were drawn in the field directly onto recent low-altitude, black and white, digitally rectified aerial photographs (USACE 1998). Wetlands vegetation and land cover types are indicated by an asterisk (*) in the legend.

open area is apparently frequented by human visitors, and debris, evidence of campfires, and motorcycle tracks are present throughout.

4.11.3 Water Quality

Surface water quality was not measured at site TWC21 during the field studies because of equipment malfunctions. Consequently, because they are not connected to the tide on Oyster Creek, it is assumed that the system of ditches and ponds on the site are all freshwater (they are possibly brackish, but this is unlikely, considering their apparent total isolation from the tide). Based on field observations of these features, it is also assumed that these water bodies are relatively shallow, poorly-flushed (i.e., stagnant), and possess relatively low levels of dissolved oxygen. It is, therefore, assumed that the water quality in these surface water features is relatively poor, and of relatively low value to wildlife. Based on other recent available water quality data on the salinity in the vicinity of the site, the salinity near the mouth of Oyster Creek is at least 20 to 25 parts per thousand or higher (refer to Restoration Concept, 4.11.7).

4.11.4 Wildlife

Wildlife and their signs (tracks, scats, calls, and other identifiable physical evidence) observed at and near site TWC21 while conducting the field studies included white-tailed deer (*Odocoileus virginianus*), osprey (*Pandion haliaetus*), mute swan (*Cygnus olor*), spotted sandpiper (*Actitus macularia*), northern black racer (*Coluber constrictor constrictor*), and black rat snake (*Elaphe obsoleta obsoleta*). A group of about 5 deer was observed in the scrub-shrub area in the northwestern part of the site (area 4); based on the large amount of scrubby early forest habitats (non-phragmites) available off-site to the north and west and probable heavy restrictions on area hunting, it is surmised that there is a relatively large deer population present.

The osprey was observed flying over Oyster Creek toward the south shore carrying a fish; no active or inactive nests were observed on or anywhere near the site. A pair of mute swans were observed in the northeastern-most shallow pond in the eastern section of the site. The swans flushed upon approach to the pond; it is not known how they use the resource (e.g., temporary use, feeding, breeding, etc.). No other birds were observed on any of the ponds. This may relate to the apparently poor water quality of the ponds (i.e., few food resources), and the fact that they are virtually enclosed by dense, tall phragmites (i.e., poor visibility from predators). One spotted sandpiper was observed along the shoreline at the mouth of Oyster Creek (near some bulkheads there). It is not known whether spotted sandpipers breed in the vicinity, but appropriate habitat could exist off the site along Oyster Creek.

The black rat snake (a 36-inch-long adult) was observed on a narrow shoreline path along Oyster Creek (dense phragmites was present on one side of the path, and the creek was on the other). The black racer snake (a 28-inch-long adult) was observed along a footpath in the northwestern part of the site; of note was its unusual dark gray coloration (instead of the black typical of this species).

It should also be noted that the deer tick population on parts of the TWC21 site was unusually heavy at the time of the field studies (field scientists pulled hundreds of ticks off their

clothes during the field studies), particularly along the partially overgrown footpath along its northern boundary. This is indirect evidence of a probable large existing deer population. One other item of note is that no evidence of red foxes was observed in the large open-sandy area (area 5) in the western part of the site. This is unusual, considering almost every similar habitat on other sites studied (particularly islands) possessed evidence of at least past use. This may be indicative of the apparently heavy current human use of this part of the site (for parties, motorcycle riding, etc.).

4.11.5 Environmental Problems at the Site

Loss of Habitat from Dredging and Filling

The dredged materials fill covers the entire 111 acres of the site; the fill was presumably placed directly over the original tidal marsh along Oyster Creek. The area with the greatest quantity of fill is in area 5 in the western section of the site; fill here is 8 to 10 feet above mean high water of Oyster Creek. Other areas of the site possess between 1 foot and 6 feet of fill. The majority of the site possesses between 1 and 3 feet of fill.

Dominance by Phragmites

Site TWC21 is dominated in most areas by dense, thick, monotypic stands of phragmites marsh (areas 1, about 75 acres, or 68% of the total site). The thin layer of fill in most areas prevents regular tidal exposure or inundation of the phragmites by the saline conditions of Oyster Creek (on the order of 25 parts per thousand at the mouth). As the site is completely cut off from regular tidal fluctuation, however, it is presumed that the existing phragmites would remain entrenched on the site without intervention, particularly in area 1. It has been demonstrated that phragmites can be easily and thoroughly killed when exposed to regular tidal flooding by waters with a salinity of at least 18 parts per thousand (Barrett and Niering 1993).

4.11.6 Restoration Constraints and Other Site Information

The New Jersey Natural Heritage database indicates that records exist for one plant, awned mountain mint (*Pycnanthemum setosum*) on or near the TWC21 site. According to these records, awned mountain mint was observed on or near the site in 1993. This species is not federal or state listed, but has been assigned a state ranking indicating that it is imperiled in the state because of the small number of known occurences (6 to 20). It is apparently also relatively rare throughout the rest of its natural range. This species was not observed at the TWC21 site during the Barnegat field studies. Prior to the implementation of a final restoration design, the existing populations of awned mountain mint would be thoroughly assessed on this site so they can be avoided and protected.

The lagoon community of Forked River Beach is located to the immediate north of the northeastern part of the site, across Orlando Drive. The distance from this end of the site to the closest residences is less than 100 feet. From east to west, however, the site curves away from the community; the western part of the site is approximately 1,500 feet from the nearest residences. In addition, another smaller lagoon community exists across Oyster Creek to the

south. This community is approximately 300 feet from the closest part of the southwestern area of the site.

"Aquatic Pesticide Permits," issued by NJDEP, Pesticide Control Program would be required for all the large-scale herbicide applications in the Barnegat projects. The spray permits are typically issued under a pesticide license maintained by the pilot or airport supplying the aircraft (personal communication, Eric Schrading, USFWS).

In addition, a large area of scrub-shrub and semi-forested wetlands border the site on its northwestern side. This off-site area is grid-ditched, apparently from a historic mosquito-control effort. This area was visited only briefly during the field studies, but because of its mix of species and structure it apparently provides some value to wildlife. This is especially true of the northern part where some larger trees exist and there is relatively little phragmites present. This area would be strictly avoided during the phragmites removal operations.

No submerged aquatic vegetation was observed in any adjacent areas of Oyster Creek or in the on-site shallow ponds during the field studies.

It is critical to note that in recent meetings between the NJDEP Division of Engineering & Construction and USACE Operations, concerns were voiced that there may be a need for future dredged materials disposal on some parts or all of TWC21. Because of the complex nature of funding for such disposal activities, the timing and even the certainty of these operations are not clear at this time. It is not known at this time whether these future disposal actions would preclude all restoration activities at TWC21.

4.11.7 Restoration Concept

It is almost certain that without substantial intervention at TWC21, the firmly-entrenched phragmites marshes will remain on the site as a “virtual climax” community. Because of the relatively small quantity of fill throughout most of areas 1, it remains very wet (fed by fresh surface and ground water) and possesses disturbed substrate (i.e., dredged materials), providing almost perfect conditions for the growth of phragmites. Simply treating the phragmites with herbicides would not likely be successful in the absence of other intervention, because near perfect physical conditions would remain for its re-growth. The best way to rid all or parts of areas 1 of phragmites would be to re-introduce tidal flow of saline water from Oyster Creek. This could be accomplished by breaking through the northeastern end of the site with a meandering channel that flows from the Bay through the phragmites marsh. With the relatively high salinity of the Bay and Oyster Creek water flowing through and flooding the phragmites on the regular tidal cycle, these marshes could be converted to saline marshes (i.e., cordgrasses, salt hay, salt-tolerant rushes, high tide bush, etc.). As an additional benefit, the re-established regular tidal flow would help to discourage mosquito breeding in this part of the site (that is in fact closest to existing residents).

Such substantial intervention would restore valuable tidal marsh at the site, but it could be prohibitively costly to restore the entire site. It is proposed, therefore, to concentrate the major restoration work in the eastern-most section of the site. The reason for this is twofold: (1)

the fill is least deep throughout this area (requiring less excavation and cost than in other areas), and (2) this area, being lower in elevation, would lend itself to better tidal flooding, and thus would stand the best chance for phragmites elimination.

A meandering 100-foot wide channel about 3 feet deep would be cut from the Bay side of the site near its northeastern corner and connect in an arc through the existing shallow ponds, and then into the large pond in the eastern-most part of the central section of the site. The new channel would then exit the site to the southeast of the large pond, and flow back into the Bay. The concept of the channel would be to mimic the natural, meandering pattern typically found in small tidal streams in the area. Measuring directly from the aerial photograph covering the site, the channel would be a total length of roughly 2,000 feet. It is estimated that with successful re-establishment of tidal flow that phragmites would be eliminated without herbicide treatments. After phragmites eradication is successful and complete, it is anticipated that natural colonization of the adjacent tidal marsh species vegetation (e.g., salt water cordgrass, salt hay, salt marsh spike grass, etc.) would occur fairly rapidly. The necessity of planting the site, therefore, is not anticipated.

It may be preferable to dispose of excavated materials on the site (as opposed to barging or trucking it elsewhere). Materials taken from the excavated channel could be deposited on the existing open sandy parcel in area 5. Expansion of the open sandy habitats in area 5 would likely benefit the diamondback terrapin (*Malaclemys terrapin*) by providing additional egg-laying habitats. It would either be possible to make the existing open sandy area slightly higher, or the habitat could be expanded into the parcel of area 3 immediately to the east, where phragmites is partially dominant. The quantity of material generated by the channel excavation (about 22,222 cubic yards) would raise the existing area 5 (4.93 acres) slightly less than 3 vertical feet. If the material were spread over both area 5 and the adjacent eastern part of area 3 (roughly 8 acres combined), it would raise it by about 1.7 vertical feet. Expansion of the sandy habitats into area 3 would require at least one herbicide treatment to remove phragmites from the parcel prior to the deposition of new material.

4.11.8 Project Implementation

Based on a 100-foot-wide channel that is 3 feet deep and 2,000 feet long, approximately 22,222 cubic yards of material would have to be excavated and removed from the site to create the tidal channel. The channel could be created using dragline or dredging equipment. The equipment could be brought in by barge or similar craft along its northeastern corner. The channel cutting would then proceed in an arc, generally from the northeast to the southwest and then back to the southeast; generated material could be either deposited in area 5 and area 3 (both areas can easily be accessed through uplands), or barged off-site. No bog mats or other protective devices would probably be necessary for the channel cutting.

Phragmites eradication at this restoration site, if required, would take place at the end of the first growing season subsequent to the channel cutting (and subsequent fill disposal on area 3). For the best effect of the glyphosate herbicide, spraying of the phragmites would take place from early to mid-September. This is because the best effect of the herbicide is achieved when transport of the photosynthesized sugars from the leaves of the plants to its rhizomes is

maximized, reportedly during this time of year. Because of the open nature of the site, spraying could be accomplished either by fixed-wing craft or by helicopter (costs may be significantly lower by fixed-wing craft). For best success of removal, all phragmites eradication would be performed at one time (or on successive days). Proper care must be taken to closely follow all manufacturer application and safety guidelines, particularly regarding appropriate wind and climatological conditions. In addition, site inspections must be made beginning in late spring after the first aerial application to monitor the success of the phragmites eradication. Persistent problem areas after several treatments must be noted; these (smaller) areas would be hand-sprayed with backpack sprayers or similar devices.

Monitoring and maintenance of the site will involve a semi-annual inspection over at least three consecutive years to monitor the created habitats for success of phragmites eradication and the natural re-colonization by native tidal marsh vegetation (e.g., salt water cordgrass, salt hay, salt marsh spike grass, etc.). It is anticipated that after the channel is cut, the site will be relatively quickly re-colonized by the native tidal marsh vegetation. An approximately 85 percent minimal total vegetative cover with less than about 5 percent phragmites will be applied as a measure of success at the site.

4.11.9 Potential Environmental Impacts

It is estimated that environmental impacts resulting from the implementation of the project will be related to the exchange of about 4.6 acres of existing wetland phragmites marsh for the 100-foot-wide by 2,000 foot-long, open water channel. However, this would only be an exchange of wetland types, and would provide a clear over-all benefit over the entire eastern section of the site.

Other minor impacts could occur with the addition of sandy materials taken from the channel cutting and added to area 5 and the eastern part of area 3. While the eastern part of area 3 possesses phragmites as a major component of its vegetation, it also possesses scattered small shrubs. Area 5 is currently largely unvegetated, and is highly disturbed by human activities (and apparently sees little use by wildlife); environmental impacts are expected to be minimal here. With the expansion of the open, sandy area, relatively minor amendments (such as fencing) could help to make this area more valuable to area wildlife, such as the diamondback terrapin.

In addition, there would be a loss of the small quantity of scattered shrubs that exist in the eastern parcel of area 3, where phragmites eradication would take place. Herbicides containing glyphosate are non-selective, and will slowly kill virtually all vegetation that they contact. Such losses will be minimized with the selection and use of the most appropriate spray equipment (e.g., spray nozzles, booms, etc.) and their use during optimal atmospheric conditions. Applied correctly in the appropriate concentrations, the herbicide is not anticipated to cause any negative effects to existing invertebrates, fish, and wildlife currently using the sites.

Implementation of the project would not likely result in any additional significant positive or negative impacts relating to air quality and noise levels, water quality, wetlands and other special aquatic areas, finfish, including Essential Fish Habitat, wildlife resources including,

but not limited to, the target species that have been identified, and threatened and endangered species.

4.11.10 Estimated Costs

The following approximate estimated costs relate to the principal elements of the project implementation at site TWC21, as stated above. The costs listed are approximate only, subject to change, and are primarily intended to provide perspective of the relative magnitude of the project. It must also be noted that where a range of costs for each item was available, the maximum cost was used.

Channel cutting/sandy material disposal/transportation/spreading:
22,222 cubic yards @ $35.00 per c.y. = $777,770

Phragmites eradication:
Aerial herbicide: 3 acres @ $79.00 per acre = $237.00

Monitoring and maintenance:
Site inspections/phragmites mapping/backpack spraying: $800.00 X 6 visits = $4,800.00

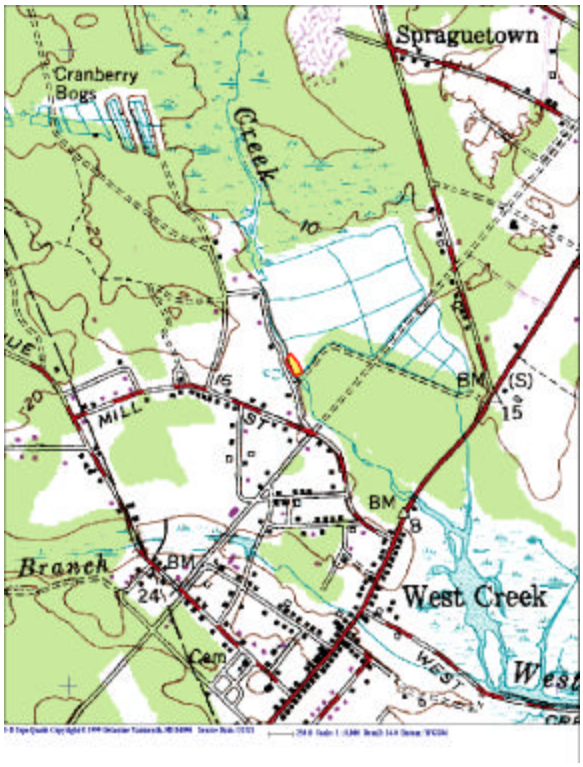
GRAND TOTAL = $782,807

4.12 SITE NWS03 (SILVER LAKE)

4.12.1 Site Description and Ownership

Site NWS03 consists of a small concrete structure, part of a former cranberry bog operation on Westecunk Creek. It is privately owned in part (land access to the site is privately owned, but the structure is owned by the state). The site is located on Westecunk Creek, off Silver Lake Drive (about 0.25 mile north of Route 9) in West Creek. Anecdotal information indicates that the bogs were directly to the east of the site, in what is now Atlantic white cedar wetlands. As mapped on Figure 4-12, the site, including open water, the structure, and wetland forests, is 5.23 acres.

The ecological problem at the site is directly related to a small concrete structure in Westecunk Creek that was formerly used as part of a narrow-gauge railroad in the cranberry operation. The structure consists of two earthen ramps (one on each bank of the creek) with partial concrete sides, and a series of three narrow vertical concrete slabs. The concrete slabs sit on a long concrete foundation that lies about 18 to 20 inches above the water. Because of its position above the water, the foundation portion of the structure likely presents a blockage to upstream migration of fish, particularly during low flows. A bypass structure is present on the right bank of the stream, but it may be ineffective at passing fish because it is very narrow and shallow (particularly during low flows). From measurements taken during the field studies, the total length of the structure is approximately 101 feet, 5 inches long; it varies from about 10 to 20 feet wide, and is about 10 feet tall from the surface of the water to the top. The center portion of the structure, containing the foundation that presents the blockage (and supporting the three large vertical plates), is approximately 19 feet long. Refer to Appendix B for the field data sheets for site NWS03.



NWS03A. View looking north at site NWS03 from downstream on Westecunk Creek. The vertical concrete plates in the photo (part of a dilapidated cranberry bog water control structure) are attached to a concrete sill that presents a blockage to movement of fish, eels, and other aquatic organisms. The vertical plates and the sill must be removed to correct the blockage.

NWS03B. Detail view of small bypass structure at NWS03, located along the right bank of Westecunk Creek (left side, but out of view in photo above).

4.12.2 Vegetation and Land Cover

The principal vegetation types in the vicinity of the NWS03 site are Atlantic white cedar forest (Figure 4-12, areas 1) and mixed deciduous wetland forest (areas 4). The Atlantic white cedar forest occurs to the north of the structure on both sides of the creek; the mixed deciduous wetland forest occurs to the south of the structure on both sides of the creek. The Atlantic white cedar forest at the site is clearly dominated by dense growths of Atlantic white cedar (*Chamaecyparis thyoides*), with a sparse shrub/woody vine layer of highbush blueberry (*Vaccinium corymbosum*), and large cranberry (*Vaccinium macrocarpon*). Other species are occasionally present, such as sweet pepperbush (*Clethra alnifolia*) and speckled alder (*Alnus rugosa*). The herbaceous layer in the cedar forest was sparse to nonexistent because of the dense canopy of the forest tree layer. The mixed deciduous wetland forest contained more of a mixture of species, and was very dense. Principal trees included Atlantic white cedar, red maple (*Acer rubrum*), and black gum (*Nyssa sylvatica*). The shrub layer was sparse to moderately dense, and was dominated by highbush blueberry and sweet pepperbush. Royal fern (*Osmunda regalis*) and cinnamon fern (*Osmunda cinnamomea*) were the only plants observed in the sparse herbaceous layer.

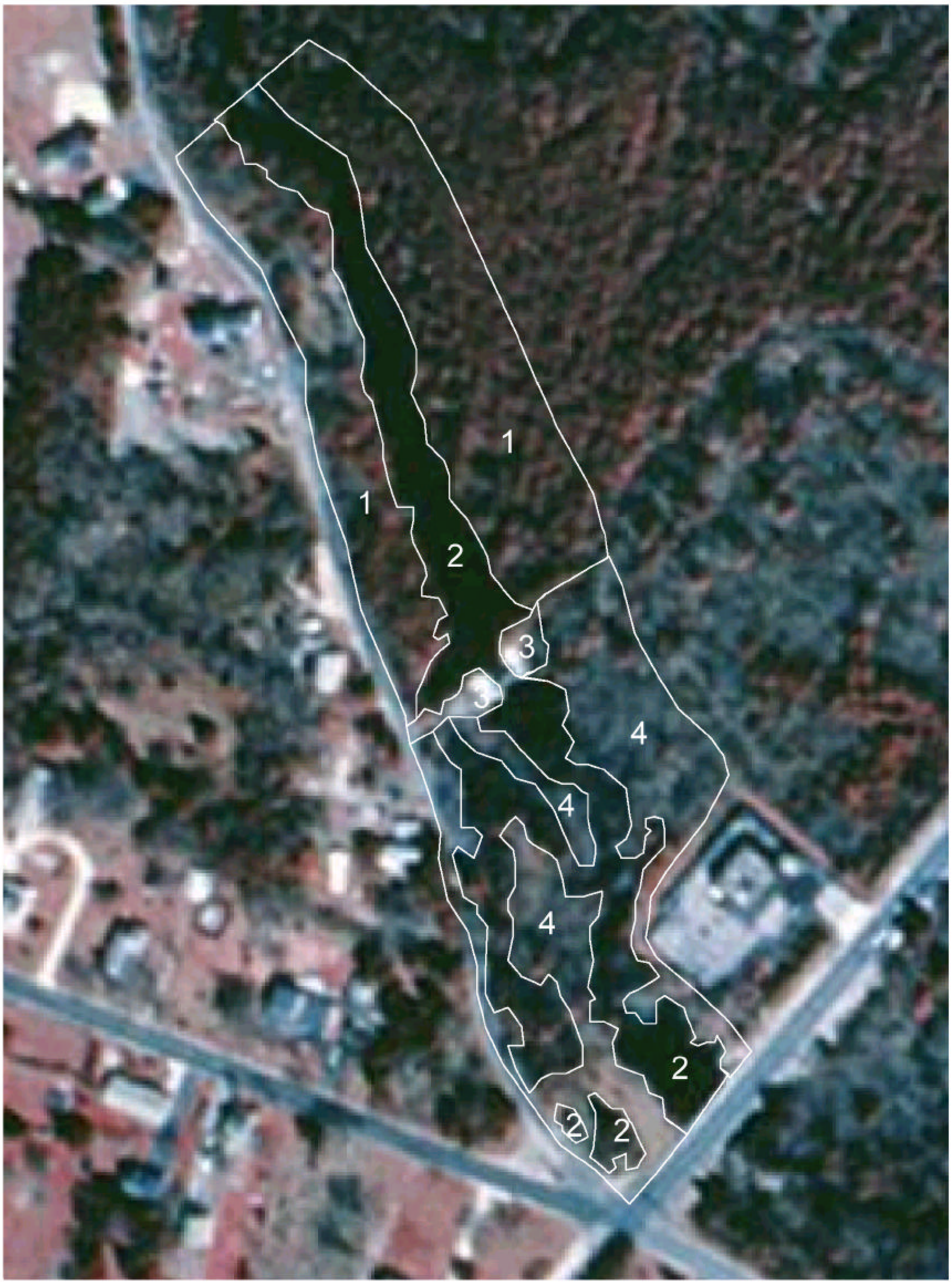
Other land cover features at the site include the open water of Westecunk Creek (areas 2), and the structure (area 3). Westecunk Creek has several branches below the structure, owing to the bypass on the western side (right bank) of the structure. The site is bounded to the west by Silver Lake Drive and to the south by Railroad Avenue. Several residences exist on the west side of Silver Lake Drive, and a county-operated facility is present on Railroad Avenue.

4.12.3 Water Quality

Surface water quality was measured at two locations in Westecunk Creek on the NWS03 site (refer to Section 2.2 Methods, Water Quality for a description of the equipment used); Table 4-8 presents results. In addition, physical stream habitat assessments were conducted at two locations, one immediately upstream of the structure, and another approximately 200 feet downstream of the structure (refer to Appendix B for field data sheets).

Several items of note were observed during the water quality data collection in the vicinity of NWS03. The pH of Westecunk Creek was acidic; it was about 5.0 in one location (upstream), and 4.4 in the other (downstream). The water temperature in the creek was fairly cold; both locations were less than 20 °C, and the flow was also relatively swift. (Refer to NWS03 data sheets, Appendix B).

Physical habitats at the site are of moderately good quality, although they were somewhat degraded because of the structure and the proximity of Silver Spring Drive along the right bank of the creek. Upstream, they rated “optimal” for channel flow status, bank stability, and vegetative protection, “suboptimal” for epifaunal substrate/available



NWS03

Map features [acres]

* 1 = Atlantic White Cedar wetlands [2.03]
* 2 = Open water [1.72]
3 = Water control structure [0.10]
* 4 = Mixed deciduous forest-wetlands [1.38]

0 100 200 Feet

N W E S

Figure 4-12. Vegetation and land cover of site NWS03. Features were drawn in the field directly onto recent low-altitude, black and white, digitally rectified aerial photographs (NJDEP 1997). Wetlands vegetation and land cover types are indicated by an asterisk (*) in the legend.

cover, substrate, sediment deposition, channel alteration, and riparian vegetative zone width categories, and "marginal" for pool variability and channel sinuosity. Physical habitat scores downstream of the site were essentially the same, with the exception of the "sediment deposition" category, which rated lower downstream than upstream. Several large point bars and deposits of new gravel and sand were observed downstream of the site; these were attributed to the presence of the structure immediately upstream.

It should also be noted that a narrow, old cranberry bog operation canal exists immediately upstream of the structure on the left bank of the creek. The canal is apparently connected to a series of meandering ditches that were part of the historic cranberry operation. It is possible that the apparently stagnant, low-dissolved-oxygen water in the canal periodically washes into the creek, temporarily degrading water quality.

Table 4-8. Results of water quality testing done at Site NWS03 for the Barnegat Environmental Testing field studies.

Sampling Location	pH	Salinity (o/oo)	D.O. (mg/L)	Specific Conductivity (mS/cm)	Temp (°C)	Turbidity (NTU)
W1 (Westecunk Creek, immed. upstream of structure; 1.5 ft.)	5.13	0.02	8.80	0.038	18.59	20.4
W2 (Westecunk Creek, 200 ft. downstream of structure; 0.7 ft.)	4.42	0.02	8.73	0.038	19.59	21.2

4.12.4 Wildlife

Wildlife and their signs (tracks, scats, calls, and other identifiable physical evidence) were observed at and near site NWS03 while conducting the field studies. Because of the relatively small size of the site and its proximity to residences and the road, few wildlife species were observed during the field studies. In addition, the creek immediately below the structure is apparently a popular "swimming hole" in the summer months, further explaining the general lack of wildlife observed. An adjacent resident raises ducks, geese, and other birds; some of these birds were occasionally observed using the creek in the vicinity of the site. Information from local residents indicates that there are occasional grass pickerel (*Esox vermiculatus*) that frequent the reach of the creek immediately upstream from the structure.

It is important to note that local professional anglers (there are apparently many that live along the southern portion of Westecunk Creek below Route 9) have indicated that alewife (*Alosa pseudoharengus*) exist in Westecunk Creek upstream to the structure at NWS03. These anglers are believed by NJDEP Division of Fish and Wildlife to be reliable sources of information on the local fisheries (personal communication, W. Tonnesen, NJDEP). The apparent presence of alewife here in the creek (in the context of

the known stream chemistry and physical habitat) may provide justification for restoration of anadromous fish passage at sites NWS03 and NWS02 (Stafford Forge).

4.12.5 Environmental Problems at the Site

Loss of Habitat from Other Hydrological Modifications

The construction of the water control/narrow gauge railroad structure for cranberry production at the site flooded valuable stream, wetland, and upland habitats. This water control structure likely also serves as an upstream barrier to anadromous (herring), catadromous (eel), and resident fish populations on Westecunk Creek. The presence of the structure at this site downstream of Stafford Forge has important implications for establishing the anadromous fishery in the upper watershed. Removal of at least portions (i.e., foundation) of this structure is critical for allowing upstream fish passage in Westecunk Creek.

4.12.6 Restoration Constraints and Other Site Information

Records from the New Jersey Natural Heritage database indicate that historic records exist for two plants in the immediate vicinity of the site; these are Barratt's sedge (*Carex barrattii*) and pine barren bellwort (*Uvularia puberula* var. *nitida*). According to Heritage, Barratt's sedge was observed in 1911, and pine barren bellwort was observed in 1907. Barratt's sedge is listed by the Pinelands Commission as 'LP' (threatened or endangered); it is not otherwise state or federal-listed, but is apparently rare throughout its natural range. Pine barren bellwort is state-listed as Endangered (but is secure throughout its entire natural range). Neither of these plant species were observed on numerous visits to the site during the field studies. Further, based on the age of the records for these species (nearly 100 years ago), and the disturbance to the site from the former cranberry bog operations, it is unlikely they still occur here.

The only real potential constraint to restoration at this site is the fact that access to it is privately owned; an easement or other agreement would have to be negotiated with the landowner for access. It is not known at this time whether such an agreement could be made with the landowner. Access could be made by small equipment from the existing upland land bridge; providing best management practices and soil erosion and sediment control measures were employed, impacts to the creek would likely only be temporary and minor. Permits would likely be required from the NJDEP Land Use Regulation Program (and possibly other entities) for working in the creek. Technically, the structure removal work would be relatively easy. It is envisioned that once the structure is removed from the creek, it will reach equilibrium relatively quickly; future related impacts would not be likely.

4.12.7 Restoration Concept

The primary concept for restoration at NWS03 is establishment of an anadromous fishery in Westecunk Creek (in conjunction with the restoration proposed for site

NWS02, Stafford Forge). The project would also benefit catadromous fish (American eels) as well as non-anadromous fish and benthic organisms. It is also presumed that the physical habitat of Westecunk Creek would also be slightly improved with implementation of the project.

4.12.8 Project Implementation

At a minimum, the foundation portion of the structure and the three vertical cement slabs would be removed from the creek. The structures could be easily reached (with land owner permission) by the over-land access connecting the site to Silver Lake Drive. It is currently presumed that the foundation and the slabs could be removed from the creek with a relatively small piece of equipment, brought back to Silver Lake Drive, and hauled away from the site (dump truck). It is also presumed that all of the major removal work with equipment could be done from the on-land access, with minor work being done by several persons wading in the stream. It is not currently known how deep below the creek bed the foundation extends; it is presumed, however, that it extends only a few inches below the surface. The use of best management practices and soil erosion and sediment control techniques would minimize the temporary impacts to Westecunk Creek during the removal process.

The structure removal would be closely monitored by team ecologists and biologists while it is being implemented. Because of the relatively simple nature of the proposed project, long-term monitoring and maintenance of the restored NWS03 site would probably not be necessary.

4.12.9 Potential Environmental Impacts

Providing only land access is used for the mechanized equipment used to remove the structure, and that best management practices and soil erosion and sediment control techniques are followed, long-term environmental impacts resulting from the project would not be likely. Short-term impacts could include increased turbidity in the creek, temporarily reducing water quality. Such temporary impacts would probably not significantly affect wildlife in the vicinity of the project.

Implementation of the project would not likely result in any additional significant positive or negative impacts relating to air quality and noise levels, water quality, wetlands and other special aquatic areas, finfish, including Essential Fish Habitat, wildlife resources including, but not limited to, the target species that have been identified, and threatened and endangered species.

4.12.10 Estimated Costs

The following approximate estimated costs relate to the principal elements of the project implementation at site NWS03, as stated above. The costs listed are approximate only, subject to change, and are primarily intended to provide perspective of the relative

magnitude of the project. It must also be noted that where a range of costs for each item was available, the maximum cost was used.

Backhoe equipment and operator:
3 days @ $2,000.00 per day = $6,000.00

Dump Truck:
3 days @ $500.00 per day = $1,500.00

Laborers:
3-man days @ $280.00 per day = $840.00

Biologist/ecologist oversight of project:
3 person-days @ $560.00 per day = $1,680.00

GRAND TOTAL = $10,020.00

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4.13 SITE LAN05 (F-COVE ABANDONED LAGOON)

4.13.1 Site Description and Ownership

Site LAN05 is owned by the USFWS and is included within the Edwin B. Forsythe Refuge system. It is located on the west side of the Bay, about 0.75 mile north of the Route 528 bridge to Mantoloking and is a total of approximately 16.7 acres. From local anecdotal information, it was apparently dug by developers in the early-to-mid 1960s and was never used. It is apparent that the lagoon was dug entirely from the native tidal marsh. The lagoon possesses an east-west main channel that connects directly to the Bay, and has two north-south branches, giving it the appearance of a large inverted "F" on an aerial photograph. The site is bounded to the north by site LAN06, and to the south by a lagoon used for the commercial marina located directly off of Route 528.

It is important to note that this site (partly because of its easy, unrestricted access from the water) sees seasonally heavy use by boaters and anglers, and is apparently the site of many night parties (several large bonfire pits are present). Boats of all types and sizes were observed during the field studies. Footpaths exist along the west and south sides of the site. A rope swing for swimming was observed in one location. Access to the site can be gained from Route 528, but it is a fairly long walk. For all the evidence of use of the site, very little trash was apparent.

When the lagoon was dug, the excavated materials were deposited in steep piles directly adjacent to the open water. The channels of the lagoon were cut to an average depth of approximately 14 feet (see results of bathymetric survey, below). The steep piles are composed of medium to coarse sand, and are very well-drained (they also possess the only upland vegetation on this largely tidal marsh landscape; refer to Vegetation and Land Cover, below).

Substrate corings and measurements of the berms were recorded during the field studies. To aid in their description, the berms were numbered from west to east; the southern berm was numbered last (Berm 5). Berm 1 (farthest west) is an average of 71 feet wide, 12 feet tall (height above mean high water in lagoon), and is approximately 600 feet long. Berm 2 is an average of 77 feet wide, 17 feet tall, and is approximately 550 feet long. Berm 3 is an average of 83 feet wide, 25 feet tall, and is approximately 550 feet long. Berm 4 is an average of 49 feet wide, 10 feet tall, and is approximately 950 feet long. Berm 5 is an average of 49 feet wide, 10 feet tall, and is approximately 800 feet long. All of the berms are composed of medium to coarse sand, and appear to be relatively unstable (i.e., eroding) where

they are not vegetated; this situation is exacerbated by the heavy human presence at the site, particularly in the vicinity of Berm 1. No groundwater was intercepted during the substrate corings on the berms.

LAN05A. View looking east toward the LAN05 entrance in the main channel of this F-shaped abandoned lagoon site. Note the width of the main channel.

LAN05B. View looking north through arm 1 of LAN05. Note the very steep sides of the lagoon in this location and the scrubby upland vegetation that is present. Based on the bathymetric survey, the lagoon is uniformly deep, and U-shaped (refer to text).

LAN05C. Detail view of the fine-grained, foul-smelling black muck that comprises the substrate below a depth of about 10 feet from the water surface (refer to text). No benthic macroinvertebrates were observed in any of the substrate samples in this material.

4.13.2 Vegetation and Land Cover

The primary vegetation type at LAN05 is upland deciduous forest (areas 2, Figure 4-13). The forest is characterized by locally dense areas of small trees and shrubs; other areas are open and less dense. The largest trees present are black cherry (*Prunus serotina*); these are scattered, and are a maximum of about 10 inches diameter at breast height (dbh). The average size of the trees on site is about 4 to 6 inches diameter at breast height (dbh). Other tree species in the forest include sassafras (*Sasafrass albidum*) and red cedar (*Juniperus virginiana*). Shrubs and woody vines observed include bayberry (*Myrica pensylvanica*), smooth sumac (*Rhus glabra*), Virginia creeper (*Parthenocissus quinquefolia*), poison ivy (*Toxicodendron radicans*), and Japanese honeysuckle (*Lonicera japonica*). The herbaceous layer of the forest was almost nonexistent in most areas, and consisted of occasional, weak phragmites (*Phragmites australis*).

Three small parcels of dense monotypic phragmites marsh exist in the northern, central, and southern parts of the site (areas 3). One parcel mapped as shallow water (area 5) also possessed abundant phragmites (in some areas the open water was grown over by the phragmites). One very small parcel of phragmites on uplands was also mapped (area 6). The only tidal marsh observed on the site was a small parcel in the eastern-most part (area 4); salt marsh cordgrass (*Spartina alterniflora*) and salt hay (*Spartina patens*) were the principal species. The remainder of the site is composed of the deep open water of the lagoon. It should be noted that the site is bounded to the east and west by tidal marsh (similar in species composition to area 4 on the site).

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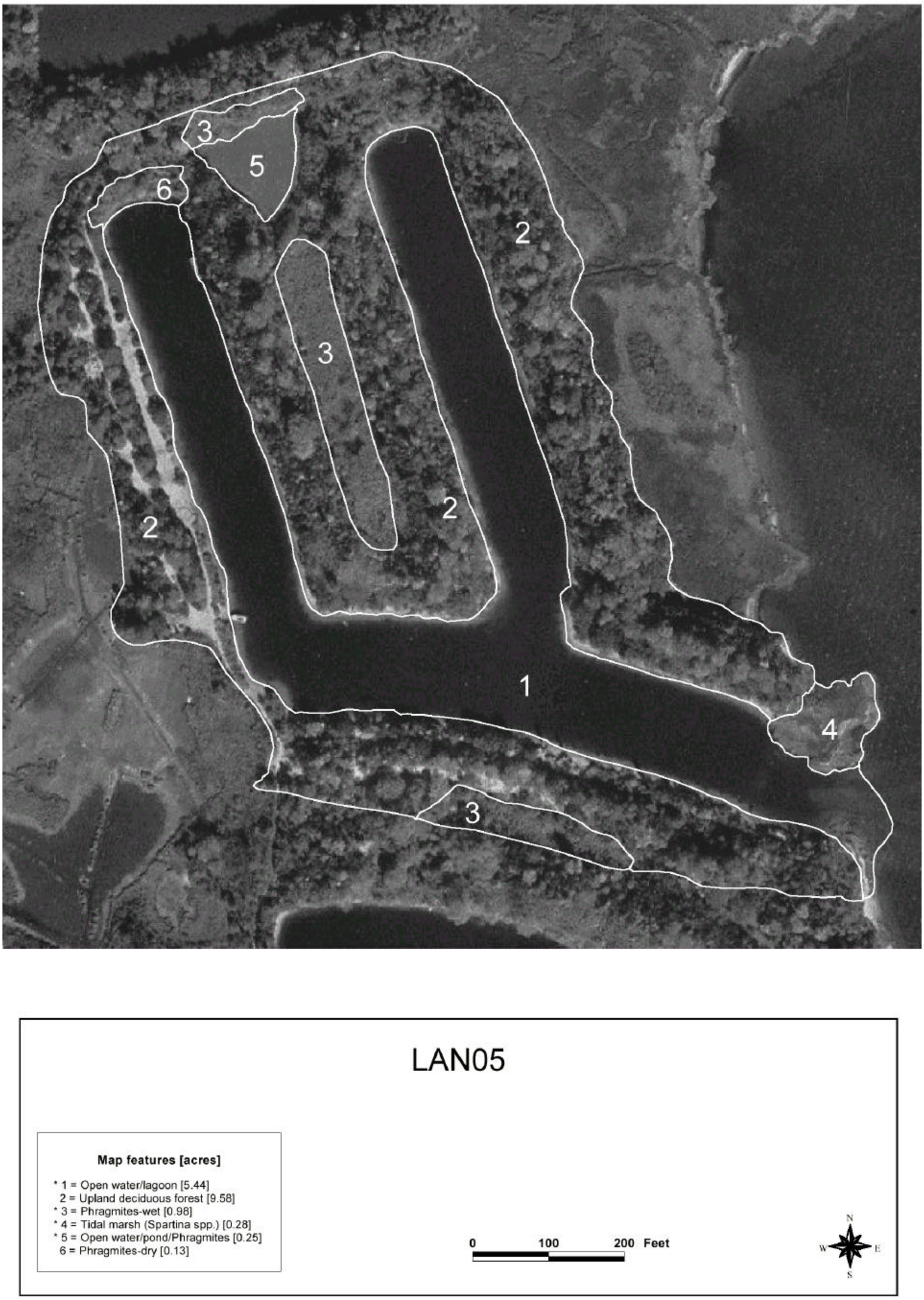

Figure 4-13. Vegetation and land cover of site LAN05. Features were drawn in the field directly onto recent low-altitude, black and white, digitally rectified aerial photographs (USACE 1998). Wetlands vegetation and land cover types are indicated by an asterisk (*) in the legend.

4.13.3 Water Quality

Surface water quality was measured at three locations on the LAN05 site (refer to Section 2.2 for a description of the equipment used); Table 4-9 presents results. Two of the sampling sites were within the deep water habitats of the main channels of the lagoon; the third sampling was done immediately off-site to the southwest in a shallow ponded habitat. Several items were of note in the lagoon. First, the salinity is high, at about 25 to 29 parts per thousand. Second, the dissolved oxygen levels were relatively high, despite depth; this is probably owing to the apparently relatively good flushing that takes place in this lagoon. Temperatures were also very cold at depth in the lagoon. Also note the difference in salinity between the off-site, isolated pond (brackish) and the sea water-strength salinity of the lagoon water (it is obvious that these two systems are not currently connected).

Table 4-9. Results of water quality testing done at Site LAN05 for the Barnegat Environmental Testing field studies.

Sampling Location	pH	Salinity (o/oo)	D.O. (mg/L)	Specific Conductivity (mS/cm)	Temp (°C)	Turbidity (NTU)
W1 (SW corner of W arm; 4 ft.)	7.54	24.46	8.92	36.95	17.49	20.9
W2 (offsite pond; 12 inches)	8.41	6.67	11.55	11.63	19.22	30.2
W3 (main channel, off E arm; 15.1 ft.)	7.25	29.18	8.30	45.02	13.99	27.0

4.13.4 Bathymetric Survey

A simplified bathymetric survey was performed to determine the approximate depths, bottom contours, and substrate of LAN05 (Table 4-10). Ten stations were evenly distributed throughout the lagoon (middle and sides); all stations were sampled for depth and dominant substrate. Detailed notes were also made at each station, where appropriate. The results of the bathymetric survey are presented in Table 4-10. From the results it is apparent that the lagoon is an average of about 14 feet deep in the middle, and the shallow shelves on the sides are about 3.5 feet deep. The lagoon possesses shallow shelves for approximately the first 10 horizontal feet and then drops precipitously into a U-shaped trough as deep as 16 feet. The substrate turns from sand to a black, hypoxic, foul-smelling, fine silt below a water depth of approximately 10 feet.

4.13.5 Wildlife

Both seining and gill netting were performed to assess the fish population of the lagoon portion of LAN05 (Table 4-11). The seine used was a 75-foot-long, 8-foot-wide net; seining was done in shallow shelves off the southeast end of the western branch, at the southwestern end of the eastern branch, and on the northern side of the entrance to the lagoon. Abundant juvenile fish were captured with the seine. It must be noted, however,

that these fish were caught only on the shallow shelves at the edges of the deep water; seining was not performed in any deep water habitats.

Table 4-10. Results of bathymetric survey performed at site LAN05 for Barnegat Environmental Testing.

Station #	Water depth (feet)	Substrate	Notes
B1	14	fine silt	black, odorous muck
B2	15	fine silt	black, odorous muck
B3	15	fine silt	black, odorous muck
B3A	10	sand/silt	depth where sand ends/silt begins
B4	14	fine silt	black, odorous muck
B5	16	fine silt	black, odorous muck
B6	11	sand/fine silt	sand with thin layer of black silt on top
B7	15	fine silt	black, odorous muck
B8	14	fine silt	black, odorous muck
B9	13	fine silt	black, odorous muck
B10	3.5	medium sand	grey sand on shallow "shelf"

Table 4-11. Combined results of seining in shallow shelf areas in three locations at site LAN05, on 1 June 2000. Seining was not performed in the deep waters of LAN05. Refer to text for sampling locations.

Scientific Name	Common Name	Notes
Fundulus heteroclitus	Mummichog	abundant (>100 total)
Menidia menidia	Atlantic silverside	abundant
Pleuronectes americanus	Winter flounder	about 16 total, each approx.1.5 inches
Callinectes sapidus	Blue crab	several small juveniles
Palaemonetes pugio	Grass shrimp	abundant
Beroe ovata	Pink comb jelly	about 20 total

An experimental gill net was deployed in the eastern branch of the lagoon overnight to determine whether adult fish use the site. No fish were captured in the gill net. Based on this result, and observations of anglers using the site (who caught no fish) during the field studies, it is apparent that few adult fish frequent these waters.

During the fish studies, it was noted that diamondback terrapins (*Malaclemys terrapin terrapin*) also frequent the area of the site. The terrapins were often observed swimming at the surface of the lagoon during the field studies (they tended to follow the research boat). One large individual (approximately 10 inches long; it may have been a female) was observed basking on an abandoned, half-submerged dock at the northern end of the western branch. Several weeks later during a subsequent visit to the site (mid-June 2000), a female terrapin (not the large individual) was observed laying eggs on the berm

immediately west of the western branch. The terrapin had dug a scrape in a very small open area in the middle of the footpath on top of the berm, and was in the process of laying eggs (several eggs were already visible in the scrape). The status of the terrapin population in the vicinity of the site is not known at this time.

Other wildlife and their signs (tracks, scats, calls, and other identifiable physical evidence) observed at and near site LAN05 while conducting the field studies included muskrat (*Ondatra zibethicus*), black-crowned night heron (*Nycticorax nycticorax*), eastern kingbird (*Tyrannus tyrannus*), yellow warbler (*Dendroica petechia*), red-winged blackbird (*Agelaius phoeniceus*), and American goldfinch (*Carduelis tristis*). One muskrat was observed in the brackish marsh off the site to the west. Approximately 6 black-crowned night herons were observed in small trees adjacent to the small triangular shallow pond (area 5) in the north-central part of the site. Despite a brief search, no night heron nests were found in the vicinity of where the birds were observed; it is not currently known how these birds use the site. Several eastern kingbirds, yellow warblers, and American goldfinches were observed flying near the edges of the lagoon; it is probable that these species all nest in the vicinity of the site. Red-winged blackbirds were observed in the vicinity of the small triangular shallow pond (area 5) in the north-central part of the site; it is also likely that they nest in this area.

4.13.6 Environmental Problems at the Site

Loss of Habitat from Dredging and Filling

The approximately 16.7-acre site was almost certainly excavated directly from the native tidal marsh, resulting in a direct loss of ecologically valuable wetlands. The lagoon was probably excavated prior to federal or state wetlands legislation (i.e., Federal Clean Water Act and the New Jersey Tidal Wetlands Act). The construction of lagoon communities in this part of Barnegat Bay has been responsible for large wetlands losses in the vicinity.

Degradation of Water Quality

Abandoned lagoons such as LAN05 add to the deterioration of local water quality in the Bay. This is primarily because they are generally deep, poorly-flushed environments where dissolved oxygen is low. LAN05, in particular, attracts and concentrates many power boats in one small area, potentially further degrading water quality.

4.13.7 Restoration Constraints and Other Site Information

The New Jersey Natural Heritage database indicates that records exist for osprey (*Pandion haliatus*) in the vicinity of the LAN05 site. According to the location description provided by Heritage, however, the 1992 record was from a location clearly off the LAN05 site. Ospreys are listed in New Jersey as Threatened and their breeding populations are considered imperiled in the state. They are globally secure, however, throughout their natural habitat. Ospreys were occasionally observed flying in the

general area; no nests were observed in any of the Barnegat study area. Based on the general nature of the proposed restoration and the size of the LAN05 site relative to adjacent habitats on the Bay, it is unlikely that ospreys would be either positively or negatively affected by the proposed restoration project.

The primary constraint to restoration of LAN05 is likely the public element. Boaters are the primary users, and anglers occasionally use the site. From observations during the field studies, it is clear that most of the users of the site are strictly passive, and bring their boats off the Bay to tie up, sleep, sunbathe, relax, etc. Anglers occasionally use the site, but fishing in the lagoon is apparently poor. Jet skiers were observed entering the site from the Bay. According to anecdotal information, the lagoon is particularly busy with boats during summer weekends. It is envisioned that with proper planning (e.g., more detailed studies of existing use), public input (during future public meetings), amenities (e.g., boat tie-ups), and signage (for "No Access Areas"), this issue will be minimized.

The only other known potential constraint is the fact that LAN05 is located directly adjacent to tidal marsh habitats (not surprising, as the site was created directly in tidal marsh). There is a large area of marsh directly to the east of the site on the Bay, and a large area of brackish marsh immediately to the west and southwest. As there is adequate access by water as well as by old road/footpath, there should be no need to access the site through the marshes. Impacts to these resources during restoration, therefore, should be minimal.

No submerged aquatic vegetation was observed at LAN05 or adjacent areas in the Bay during the field studies.

4.13.8 Restoration Concept

The concepts for restoration at LAN05 include improvements for fishery resources, particularly for juvenile fish, benthos, and other aquatic organisms, and for establishment of permanent habitats for diamondback terrapins. Other, more minor (but still important) benefits will also be realized as a part of the restoration. These will include improved water quality (as a result of better circulation), and conversion of two small areas dominated by phragmites to tidal marsh.

It is important to note that the juvenile fish caught during the seining primarily inhabit the shallow shelf areas prior to the deep drop-off of the lagoon. It is presumed that because of the deep, cold, hypoxic conditions of the bottom substrate (black muck), juvenile fish and benthos prefer to inhabit the shelves. This condition renders the majority of the bottom lagoon habitat useless to fish and benthos. It is therefore recommended that the deep, uniform U-shaped trough part of the lagoon be raised to shallower depths to provide a more oxygenated, varied environment that is conducive for both fish and benthos. The bottom contours of the lagoon should be made variable, but should be an average of about 10 feet to maximize habitats for a number of species. An abundance of sandy materials that could be used for this purpose exist on the berms

surrounding the site (in fact, these berms exist as a result of material being excavated from the marsh; returning a portion of the materials as a restoration technique after removal of the existing upland vegetation makes sense logically). Refer to the subsequent Potential Environmental Impacts section for analysis of the loss of these upland berm habitats.

In creating habitats for diamondback terrapins on the site, sandy open areas, relatively free of vegetation could be created and maintained in the center of the site, between the western and eastern branches. Maintenance of the open habitats would likely be performed by spot-spraying of herbicide (i.e., with a backpack-type sprayer) during regular, scheduled monitoring visits. An island could be created (that would help to isolate the terrapins from predators and humans) by cutting an east-west channel through the uplands between the northeast corner of the western branch and the northwest corner of the eastern branch (i.e., join the two branches). The channel could also be cut so that it connects to the small triangular pond (area 5) and the long, linear north-south area of phragmites marsh (area 3). This would provide regular flushing of saline water to these areas and would rid them of phragmites (convert them to tidal marsh and saline shallow, open water habitats). It is estimated that the channel cutting could be performed with an absolute minimum of direct wetland disturbance. The scrubby upland vegetation would then be removed from all or a majority of the new island area, and the sandy substrate would be graded flat. Materials excavated from the channel cutting could either be deposited on the island or used for open water "trough filling" (as described above). It may also be appropriate to connect the northern end of LAN05 with LAN06 through a north-south branch of the channel. Because it would be dug through the upland berms, this connection could also be made with minimal impacts to existing wetlands. Implementation of this aspect would directly connect the tide from the Metedeconk River through LAN06, into LAN05, and out into the upper Bay. This connection is included as part of the restoration concept for LAN06 (subsequent section).

Other areas of the scrubby upland deciduous forest habitats at the site would be preserved intact as habitats for wildlife. They would be allowed to mature through natural ecological succession. It should be noted that although such upland forested habitats were not originally native to the site (nor even the direct vicinity of the site), they provide a small amount of marginal habitat for wildlife such as songbirds.

It is not certain how the current human uses would be accommodated by the restoration. The lagoon would be made much shallower and access by large watercraft at low tide could be difficult. Small watercraft would likely still be able to access the site. It is not clear at this time whether such access by watercraft would diminish the ecological values of the restored site. In addition, the open, sandy areas created by terrapin habitats would definitely have to be fenced to assure success. It is important to note, however, that the existing berm habitats appear to be only rarely used by humans anyway.

4.13.9 Project Implementation

To create a 250-foot long, 50-foot wide, 10-foot-deep channel that would connect the top parts of the western and eastern branches of the lagoon, approximately 4,630 cubic yards of material must be excavated from the uplands. The material could then be deposited on the newly-created upland island area, or could be used to raise the bottom of the lagoon (see below). The dragline or other equipment could be brought in by barge or similar craft through the main lagoon channel and then into the western branch. The channel cutting would then proceed from west to east; generated material could be used for creation of diamondback terrapin habitats on the newly-created upland island, or used for bottom-raising in the lagoon troughs. No bog mats or other protective devices would probably be necessary for the channel cutting.

To raise the bottom of the lagoon to an average of 10 feet, sandy, excavated material would have to be added. By applying the information from the bathymetric survey and direct measurement of the aerial photograph, this volume can be calculated. Not including the side shelves (which are10 feet wide on both sides and shallower), the main branch of the lagoon is essentially a U-shaped trough that is 700 feet long, 100 feet wide, and 16 feet deep. The calculation for materials to fill the trough to an average of 10 feet would be 700 feet X 100 feet X 6 feet = 420,000 cubic feet = 15,556 cubic yards. A similar calculation can be applied for the western and eastern branches. For the western branch, it is 650 feet X 80 feet X 6 feet = 312,000 cubic feet = 11,556 cubic yards. For the eastern branch, it is 725 feet X 85 feet X 6 feet = 369,750 cubic feet = 13,694 cubic yards. The total amount of fill to raise the lagoon to an average of 10 feet would be 15,556 + 11,556 + 13,694 = 40,806 cubic yards. If sandy materials from the east-west channel cutting were used in the bottom-raising, the total materials required would be 40,806 – 4,630 = 36,176 cubic yards.

To put the amount of fill required in perspective (based on the measurements defined under Site Description, above), Berm 1 contains an estimated 18,933 cubic yards of sandy materials; Berm 2 contains an estimated 26,665 cubic yards; Berm 3 contains an estimated 42,269 cubic yards; Berm 4 contains an estimated 17,241 cubic yards; and Berm 5 contains an estimated 14,519 cubic yards. Based on these estimated quantities of materials available on-site, it is apparent that materials required for the lagoon bottom-raising could be taken solely from a combination of these berms and the east-west channel cutting (if implemented). Use of all or part of Berm 4 as fill material could also provide an additional benefit of restoring tidal wetlands along the Bay side of the site. The existing tidal wetlands on the Bay side of the site are saline; phragmites would not colonize here if the restored area was excavated to the proper elevation. It is not recommended, however, that all of Berm 1 be used as fill material. This berm currently separates the saline waters of the lagoon from the brackish marsh off-site to the immediate west-northwest. Breaching of this berm would permanently alter the chemistry (and thus, the vegetative community) of the brackish marsh. Equipment for berm excavation could be brought in by barge or similar craft through the main lagoon channel and then into the eastern and/or western branches. The materials excavation would then proceed from the water. Alternatively, the excavation equipment could be

brought in by land via the small, existing sand roads. It is not certain at this time, however, if these roads could support such an operation without maintenance.

Once the island has been created by completing the east-west channel, it must be cleared of vegetation, and the sand must be graded so that the entire area is nearly flat. It is estimated that once this process is completed, very little would need to be done to prepare the island for use by diamondback terrapins aside from installation of protective fencing.

Monitoring and maintenance of the restored LAN05 site will require long-term (but not necessarily complex) studies of the lagoon fishery, as well as monitoring of the created diamondback terrapin habitats to ensure their effectiveness. As part of the monitoring, the two small areas of phragmites that would be converted to tidal marsh should also be included to confirm that phragmites has been eliminated from those systems.

4.13.10 Potential Environmental Impacts

Elements of the proposed restoration would result in a loss of on-site scrubby upland forest habitat (within area 2, Figure 4-13). A total of 2 acres of habitat would be lost to create the island area for diamondback terrapins and the restoration of the small tidal wetland area. About 0.11 acre of this upland habitat would also be lost as a result of the north-south channel cutting. No mature trees, however, exist on any of these steeply-sided berms, and the vegetation is generally sparse and scrubby. Many of the predominant vegetative species are introduced invasives. These habitats are not originally native to the site and are a direct result of tidal wetland destruction when the lagoon was dug. Other similar habitats exist off the site to the south and adjacent to LAN06, to the north. The berms, however, probably provide a small amount of habitat for songbirds and other wildlife. It is proposed, therefore, to preserve a portion of these habitats as they exist on Berm 1, but to use other berms as sources of fill material.

With implementation of appropriate soil erosion and sediment control measures, the proposed activities, including creation of the island habitats (vegetation clearing and grading), clearing the required berm borrow areas of vegetation and material excavation, would pose minimal impacts on ecological resources. Such measures could include use of silt curtains, hay bales, temporary seeding of steep exposed slopes, etc.

Implementation of the project would not likely result in any additional significant positive or negative impacts relating to air quality and noise levels, water quality, wetlands and other special aquatic areas, finfish, including Essential Fish Habitat, wildlife resources including, but not limited to, the target species that have been identified, and threatened and endangered species.

4.13.11 Estimated Costs

The following approximate estimated costs relate to the principal elements of the project implementation at site LAN05, as stated above. The costs listed are approximate only, subject to change, and are primarily intended to provide perspective of the relative magnitude of the project. It must also be noted that where a range of costs for each item was available, the maximum cost was used.

East-west channel cutting:
4,630 cubic yards @ $35.00 per c.y. = $152,600

Sandy material excavation from berms/deposition in lagoon:
36,176 cubic yards @ $35.00 per c.y. = $1,266,160

Vegetation clearing:
$500 per day X 10 days = $5,000

Monitoring and maintenance:
Site inspections and monitoring: $800.00 X 6 visits = $4,800.00

GRAND TOTAL = $1,428,560

4.14 SITE LAN06 (L-COVE ABANDONED LAGOON)

4.14.1 Site Description and Ownership

Site LAN06 is owned by the USFWS and is included within the Edwin B. Forsythe Refuge system. It is located off the south side of the Metedeconk River, about 0.25-mile west of its confluence with Barnegat Bay (it is immediately north of site LAN05) and is a total of approximately 13 acres. From local anecdotal information, it was apparently dug by developers in the early-to-mid 1960s (at the same time as LAN05) and was never used. It is apparent that the lagoon was dug entirely from the native tidal marsh. The lagoon possesses two branches, one essentially oriented east-west, and the other oriented north-south, giving it the appearance of a large inverted "L" on an aerial photograph. The site is bounded to the south by site LAN05, to the north by tidal marsh adjacent to the Metedeconk River, and to the east by upper Barnegat Bay.

Because access to this site is very difficult (i.e., via very shallow, narrow waterways or via footpaths), the site is apparently little used (it is an even longer walk from the closest land access at Route 528 to this site than to LAN05). Access to the site by water for the field studies was difficult, even using a small john boat at high tide. Little trash or other signs of human use were apparent in the vicinity of LAN06 during the field studies.

When the lagoon was dug, the excavated materials were deposited in steep piles directly adjacent to the open water. The channels of the lagoon were dug to an average depth of approximately 14 feet (see results of bathymetric survey below). The steep piles are composed of medium to coarse sand and are very well-drained (they possess the only upland vegetation on this largely tidal marsh landscape; refer to Vegetation and Land Cover, below).

Substrate corings and measurements of the berms were recorded during the field studies. Two berms exist at the site; for convenience, the northern-most berm is called Berm 1 and the southern berm is called Berm 2. In essence, Berm 1 is a large, L-shaped, steep-sided pile of excavated sandy material. It is an average of roughly 96 feet wide, 800 feet long, and 15 feet tall (height above mean high water in lagoon). Berm 2 is an average of 65 feet wide, 600 feet long, and 10 feet tall. Both are composed of medium to coarse sand and appear to be relatively

LAN06A. View looking northeast through abandoned lagoon site LAN06. Note the very steep sides of the lagoon in this location and the scrubby upland vegetation that is present. Based on the bathymetric survey, the lagoon is uniformly deep, and U-shaped (refer to text). Because it is only connected by a long, narrow channel to the Metedeconk River, the lagoon is relatively isolated from the tide.

LAN06B. Detail view of a juvenile bluefish (*Pomatomus saltatrix*) caught during seining studies conducted at LAN06.

LAN06C. View looking south at the north berm of the lagoon at LAN06 from tidal marsh. Note the scrubby nature of the upland vegetation on the berm and the abrupt upland/wetland transition. The principal tidal marsh species in this location is *Spartina patens.*

LAN06D. View looking south at the western end of the southern berm. Note that the berm is relatively flat in this location, as well as the scrubby upland vegetation and the large concrete block (likely put in place when the lagoon was constructed).

unstable (i.e., eroding) where they are not vegetated. No groundwater was intercepted during the substrate corings on the berms.

4.14.2 Vegetation and Land Cover

The primary upland vegetation type on the site is deciduous forest (area 2, Figure 4-14). The forest is characterized by locally dense areas of small trees and shrubs; other areas are open and less dense. The largest trees present are black cherry (*Prunus serotina*); these are scattered and are a maximum of about 10 inches in diameter at breast height (dbh). The average size of the trees on site is about 4 to 6 inches dbh. Other tree species in the forest include sassafras (*Sasafrass albidum*) and red cedar (*Juniperus virginiana*). Shrubs and woody vines observed include bayberry (*Myrica pensylvanica*), smooth sumac (*Rhus glabra*), Virginia creeper (*Parthenocissus quinquefolia*), poison ivy (*Toxicodendron radicans*), and Japanese honeysuckle (*Lonicera japonica*). The herbaceous layer of the forest was almost nonexistent in most areas and consisted of occasional, weak phragmites (*Phragmites australis*). A large parcel of tidal marsh actually composesthe majority of the vegetation at the site as mapped. This large area of tidal marsh was included as part of the site so that it could be protected during future restoration efforts. The tidal marsh is relatively undisturbed; its principal species are salt marsh cordgrass (*Spartina alterniflora*), salt hay (*Spartina patens*), marsh spike grass (*Distichlis spicata*), and high tide bush (*Iva frutescens*). It should also be noted that a large area exists to the northwest of the site where the tidal marsh is apparently disturbed by small amounts of fill; this area possesses an odd mixture of red cedar (*Juniperus virginiana*), high tide bush, and both species of cordgrass. An abandoned road or railroad line (now a narrow footpath) extends off the site from its eastern end into the marsh to the west. It appears that this feature was somehow connected to both the site and to the off-site area possessing the red cedars (it may have been used as a haul road to transport equipment on and off the site). A similar abandoned road (now a footpath) also extends from the eastern end of the site out into the tidal marsh.

4.14.3 Water Quality

Surface water quality was measured at two depths in one location on the LAN06 site (refer to Section 2.2 for a description of the equipment used); Table 4-12 presents results. A remote HydroLab unit was set at an additional deep water location to record data at 15 minute intervals over 24 hours in the lagoon (refer to Appendix B for data). All three of the sampling sites were within the deep water habitats of the main channel of the lagoon. Several items were of note in the lagoon. First, the salinity is high, at about 28 to 29 parts per thousand. Second, the dissolved oxygen levels were much lower than in the LAN05 site; this is probably a result of the depth and the very poor flushing that exists in this lagoon. At an average of only about 3 milligrams per liter (with low readings at less than 2 mg/L), the lower levels of the lagoon do not provide a habitat suitable for many biota. Temperatures were also very cold at this depth in the lagoon. Over 24 hours the parameters were very stable, most likely indicating poor flushing and tidal exchange.

Figure 4-14. Vegetation and land cover of site LAN06. Features were drawn in the field directly onto recent low-altitude, black and white, digitally rectified aerial photographs (USACE 1998). Wetlands vegetation and land cover types are indicated by an asterisk (*) in the legend.

Table 4-12. Results of water quality testing done at Site LAN06 for the Barnegat Environmental Testing field studies. Refer to Appendix B for 24-hour data from this site.

Sampling Location	pH	Salinity (o/oo)	D.O. (mg/L)	Specific Conductivity (mS/cm)	Temp (°C)	Turbidity (NTU)
W1 (western end, 5.1 meters)	6.17	28.88	1.43	44.81	11.33	40.5
W1A (same as W1, 1.1 meters)	7.30	21.84	9.50	34.85	28.02	28.8

4.14.4 Bathymetric Survey

A simplified bathymetric survey was performed to determine the approximate depths, bottom contours, and substrate of LAN06. Eleven stations were evenly distributed throughout the lagoon (middle and sides); all stations were sampled for depth and dominant substrate. Detailed notes were also made at each station, where appropriate. The results of the bathymetric survey are presented in Table 4-13. From the results, it is apparent that the lagoon is an average of about 14 feet deep in the middle with shallow shelves on the sides about 4.0 feet deep. The lagoon possesses shallow shelves for approximately the first 10 horizontal feet and then drops precipitously into a U-shaped trough as deep as 15 feet. The substrate turns from sand to a black, hypoxic, foul-smelling, fine silt below a water depth of approximately 5 feet.

Table 4-13. Results of bathymetric survey performed at site LAN06 for Barnegat Environmental Testing.

Station #	Water depth (feet)	Substrate	Notes
A	15.00	fine silt	black, odorous muck
B	5.00	coarse sand	sand with thin top layer of mud; break point here
C	15.00	fine silt	black, odorous muck
D	15.00	fine silt	black, odorous muck
E	13.00	fine silt	black, odorous muck
F	14.00	fine silt	black, odorous muck
G	14.00	fine silt	black, odorous muck
H	11.00	fine silt	black, odorous muck
I	5.00	coarse sand	sand with thin top layer of mud; break point here
J	4.00	coarse sand	small shoal area, inside “L” bend
K	11.00	fine silt	black, odorous muck

4.14.5 Wildlife

Seining was conducted in two locations to assess the fish population of the lagoon portion of LAN06. The seine used was a 75-foot-long, 8-foot-wide net; seining was done in shallow shelves off the southwestern end and inside the bend of the "L" near the eastern end. Abundant juvenile fish were captured with the seine; seining was not performed in any deep water habitats.

Table 4-14. Combined results of seining in shallow shelf areas in two locations at site LAN06, on 27 June 2000. Seining was not conducted in the deep waters of LAN06. Refer to text for sampling locations.

Scientific Name	Common Name	Notes
Fundulus heteroclitus	Mummichog	abundant (>100 total)
Fundulus majalis	Striped killifish	abundant
Menidia menidia	Atlantic silverside	abundant
Brevoortia tyrannus	Atlantic menhaden	several individuals
Mugil cephalus	Striped mullet	several individuals
Leiostomus xanthurus	Spot	several individuals
Pomatomus saltatrix	Bluefish	several small juveniles
Callinectes sapidus	Blue crab	three small juveniles
Palaemonetes pugio	Grass shrimp	abundant
Beroe ovata	Pink comb jelly	abundant

Because of the gill netting results at LAN05 (where no adult fish were captured; refer to section 4.13) and the fact that LAN06 apparently possesses poor tidal exchange, no gill netting was conducted at this site.

During the field studies, it was noted that diamondback terrapins (*Malaclemys terrapin terrapin*) also frequent the area of the site. The terrapins were often observed swimming at the surface of the lagoon during the field studies (they tended to follow the research boat). No terrapins were observed on land at the site. The status of the terrapin population in the vicinity of the site is not known at this time.

Other wildlife and their signs (tracks, scats, calls, and other identifiable physical evidence) observed at and near site LAN06 while conducting the field studies included herring gull (*Larus argentatus*), greater black-backed gull (*Larus marinus*), green heron (*Butorides striatus*), and black-crowned night heron (*Nycticorax nycticorax*). All of these birds, with the exception of the green heron (one individual was seen on the western end of the site), were observed in the tidal marsh to the northeast of the site. A large, very shallow tidal pool (only a few inches deep at high tide) exists to the immediate northeast of the site, where many gulls were observed loafing and resting. No songbirds were observed in the scrubby upland forest on the berms.

4.14.6 Environmental Problems at the Site

Loss of Habitat from Dredging and Filling

The approximately 13-acre site was almost certainly excavated directly from the native tidal marsh, resulting in a direct loss of ecologically valuable wetlands. The lagoon was probably excavated prior to federal or state wetlands legislation (i.e., Federal Clean Water Act and the New Jersey Tidal Wetlands Act). The construction of lagoon communities in this part of Barnegat Bay has been responsible for large wetlands losses in the vicinity.

Degradation of Water Quality

Abandoned lagoons such as LAN06 add to the deterioration of local water quality in the Bay by creating deep, poorly-flushed environments where dissolved oxygen is low. LAN06 possesses especially poor water quality.

4.14.7 Restoration Constraints and Other Site Information

The New Jersey Natural Heritage database indicates that records exist for osprey (*Pandion haliatus*) in the vicinity of the LAN06 site. According to the location description provided by Heritage, however, the 1992 record was from a location clearly off the LAN06 site. Ospreys are listed in New Jersey as Threatened and their breeding populations are considered imperiled in the state. They are globally secure, however, throughout their natural habitat. Ospreys were occasionally observed flying in the general area; no nests were observed anywhere in the Barnegat study area. Based on the general nature of the proposed restoration and the size of the LAN06 site relative to adjacent habitats on the Bay, it is unlikely that ospreys would be either positively or negatively affected by the proposed restoration project..

As previously indicated, unlike LAN05, the need to accommodate public use is missing from site LAN06 because of the difficult boat access.

The only known potential constraint is that LAN06 is located directly adjacent to tidal marsh habitats in almost every direction (not surprising, as the site was created directly in tidal marsh) and access is currently difficult. There are large areas of marsh directly to the north, east, west, and southeast. Access would need to be improved through the existing narrow waterway that connects the site with the Metedeconk River. Because of its direct tidal connection through this channel and the existence of other smaller tidal channels, it is possible that the waterway could be slightly deepened with little direct effect to the adjacent tidal marsh. It is uncertain at this time whether deepening of the waterway would allow for passage of the equipment needed for restoration of the site (refer to 4.14.9, Project Implementation). Direct losses of wetlands must be avoided to keep this project viable.

No SAV was observed at LAN06 or adjacent areas in the Bay during the field studies.

4.14.8 Restoration Concept

The concepts for restoration at LAN06 include improvements for fishery resources, particularly for juvenile fish, benthos, and other aquatic organisms, and for establishment of permanent habitats for diamondback terrapins. Other, more minor (but still important) benefits will also be realized as a part of the restoration. These will include improved water quality (as a result of better water circulation).

It is important to note that the juvenile fish caught during the seining primarily inhabit the shallow shelf areas prior to the deep drop-off of the lagoon. It is presumed that because of the deep, cold, hypoxic conditions of the bottom substrate (black muck), juvenile fish and benthos prefer to inhabit the shelves. This condition likely renders the majority of the bottom lagoon habitat useless to fish and benthos. It is therefore recommended that the deep U-shaped trough part of the lagoon be raised to shallower depths to provide a more oxygenated, varied environment that could be used by both fish and benthos. The bottom contours of the lagoon would be made heterogenous, but would average about 10 feet deep to maximize habitats for a number of species. The 10-foot average depth is recommended because all of the fish caught during the seining were at or above this depth. Below 10 feet deep, the lagoon drops precipitously in a U-shaped trench as deep as 17 feet. Additionally, recent studies for dredged holes restoration projects in the vicinity of the site indicate an average 12-foot depth may maximize both fisheries and benthic habitats (USACE 2000). An abundance of sandy materials that could be used for this purpose exist on the berms surrounding the site (in fact, these berms exist as a result of material being excavated from the marsh).

To improve the circulation in this lagoon, an essentially north-south channel could be cut through the upland Berm 2, connecting to the small, triangular pond immediately off-site at LAN05, and then into the east-west channel dug at LAN05. To minimize direct impacts to existing wetlands in the pond, no channel would be cut into the triangular pond; the tidal flow from the new north-south channel would be allowed to flow passively through the pond and into the east-west channel (where the tide would then flow south through LAN05). While no direct physical impacts to the pond would occur, it is likely the pond would be converted from a brackish wetland dominated by phragmites to a saline spartina marsh.

In creating habitats for diamondback terrapins on the site, sandy open areas (relatively free of vegetation) could be created and maintained on either Berm 1 or Berm 2. Vegetation on the terrapin restoration areas would first have to be cleared. After vegetation clearing, the berm would have to be graded relatively flat. It may be advantageous to create such habitats on Berm 1, because a secondary benefit could also include restoration of part of the berm back to tidal marsh (during grading, a part of the berm could be completely removed or pushed aside). This concept may be more

plausible on Berm 1 because of the large quantity of existing marsh directly to the north (Berm 2 only borders tidal marsh on part of its southeastern end).

Other areas of the scrubby upland deciduous forest habitats at the site would be preserved intact as habitats for wildlife. They would be allowed to mature through natural ecological succession. It should be noted that although such upland forested habitats were not originally native to the site (nor even the vicinity of the site), they can provide a small amount of marginal habitat for wildlife such as songbirds.

4.14.9 Project Implementation

To create a 100-foot long, 50-foot wide, 10-foot-deep channel to connect LAN06 to LAN05 through the off-site triangular pond, approximately 1,852 cubic yards of material would have to be excavated from the uplands. The material could then be deposited on the newly created terrapin areas, or could be used to raise the bottom of the lagoon (see below). The dragline or other equipment could be brought in by barge or similar craft through the narrow waterway (note the waterway would have to be deepened and possibly slightly widened to allow equipment access). Alternatively, the excavation equipment could be brought in by land via the small existing sand roads. It is not certain at this time whether these roads could support such an operation without maintenance. The channel cutting would then proceed from north to south. The channel would end at the northern rim of the triangular pond. No bog mats or other protective devices would probably be necessary for the channel cutting.

To raise the bottom of the lagoon to an average of 10 feet, sandy, excavated material would have to be added. By applying the information from the bathymetric survey and direct measurement of the aerial photograph, this volume can be calculated. Not including the side shelves (which are10 feet wide on both sides and shallower), the main branch of the lagoon is essentially a U-shaped trough 700 feet long, 80 feet wide, and 14 feet deep. Filling the trough to an average of 10 feet would require 700 feet X 80 feet X 4 feet = 224,000 cubic feet = 8,296 cubic yards of material. A similar calculation can be applied for the small end section (eastern end) of the lagoon. For the end section, 200 feet X 50 feet X 4 feet = 40,000 cubic feet = 1,481 cubic yards would be needed. The total amount of fill to raise the lagoon to an average of 10 feet would be 8,296 + 1,481 = 9,777 cubic yards. If sandy materials from the north-south channel cutting were used in the bottom-raising, the total additional materials required would be 9,777 –1,852 = 7,925 cubic yards. It is possible that some of these required materials could come from widening and deepening of the narrow waterway on the north side of the site. It is not known at this time what quantity of materials the widening would generate, or whether the materials would be physically appropriate (i.e., not sand).

To put the amount of fill required in perspective (based on the measurements defined under Site Description, above), Berm 1 contains an estimated 42,667 cubic yards of sandy materials; Berm 2 contains an estimated 14,444 cubic yards. Based on these estimated quantities of materials available on-site, it is apparent that materials required for the lagoon bottom-raising could be taken solely from a combination of these berms

and the north-south channel cutting (if implemented). Use of all or part of Berm 1 as fill material could also provide an additional benefit of restoring tidal wetlands along the north side of the site. The existing tidal wetlands on the north side of the site are saline; phragmites would not colonize here if the restored area was excavated to the proper elevation.

Because diamondback terrapin habitats of essentially the same quality could be created from either Berm 1 or Berm 2, we recommend using Berm 1 for the following reasons. A much greater amount of fill exists on Berm 1 for the lagoon bottom-raising (fill could be borrowed with more of the upland forested habitat remaining intact) and an area of tidal wetlands could be restored here. Of the approximately 2 acres comprising Berm 1, approximately 1.7 acres could be cleared of vegetation and graded flat for terrapin habitat. The remaining approximately 0.30 acre of berm could be removed down to the elevation of the tidal marsh. This quantity (0.30 acre) equates to approximately 150 linear feet of Berm 1 with its current average width and depth (i.e., 96 feet wide X 150 feet long X 15 feet deep = 8,000 cubic yards; this is the quantity required for the lagoon bottom-raising). No other activities would be required for restoration of this small area of tidal wetlands.

Monitoring and maintenance of the restored LAN06 site will require long-term (but not necessarily complex) studies of the lagoon fishery, as well as monitoring of the created diamondback terrapin habitats, and the restored wetland, to ensure their effectiveness.

4.14.10 Potential Environmental Impacts

Elements of the proposed restoration would result in a loss of on-site scrubby upland forest habitat (within area 2, Figure 4-14). A total of 1.7 acres of upland habitat would be lost in creating the open area for diamondback terrapins; about 0.11 acres would also be lost as a result of the north-south channel cutting. However, no mature trees exist on any of these steeply-sided berms, and the vegetation is sparse and scrubby throughout. Many of the predominant vegetative species are introduced invasives. These habitats are not originally native of the site and are a direct result of tidal wetland destruction when the lagoon was dug. Other similar habitats exist off the site to the south and adjacent to LAN06 to the north. The berms, however, probably provide a small amount of habitat for songbirds and other wildlife. It is proposed, therefore, to preserve Berm 2 as it exists. In addition, the widening and/or deepening of the narrow waterway on the north side of the site would likely convert a very small amount of the existing tidal marsh to open water (tidal channel) habitat.

With implementation of appropriate soil erosion and sediment control measures, the proposed activities (clearing the required berm borrow areas of vegetation and material excavation) would result in minimal impacts on ecological resources. Such measures could include use of silt curtains, hay bales, temporary seeding of steep exposed slopes, etc.

Implementation of the project would not likely result in any additional significant positive or negative impacts relating to air quality and noise levels, water quality, wetlands and other special aquatic areas, finfish, including Essential Fish Habitat, wildlife resources (including, but not limited to, the target species that have been identified), and threatened and endangered species.

4.14.11 Estimated Costs

The following approximate estimated costs relate to the principal elements of the project implementation at site LAN06, as stated above. The costs listed are approximate only, subject to change, and are primarily intended to provide perspective on the relative magnitude of the project. It must also be noted that where a range of costs for each item was available, the maximum cost was used.

North-south channel cutting:
1,852 cubic yards @ $35.00 per c.y. = $64,820

Sandy material excavation from berms/deposition in lagoon:
8,000 cubic yards @ $35.00 per c.y. = $280,000
Vegetation clearing:
$500 per day X 10 days = $5,000

Monitoring and maintenance:
Site inspections and monitoring: $800.00 X 6 visits = $4,800.00

GRAND TOTAL = $354,620

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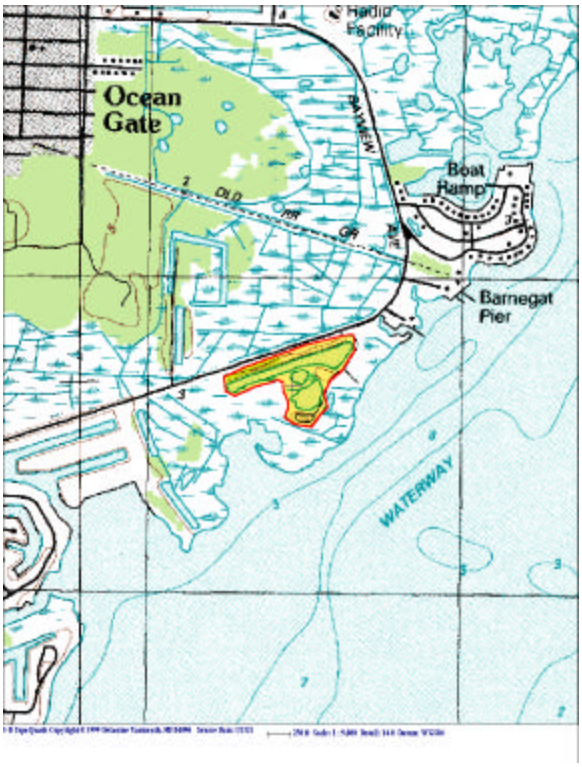
4.15 SITE LAC02 (BAYVILLE SOUTH ABANDONED LAGOON)

4.15.1 Site Description and Ownership

Site LAC02 is owned by Ocean County and is included within their Ocean County Land Trust system. It is located off the south side of Bayview Avenue east of Bayville, about 3,360 feet to the east of the intersection with Amherst Drive. From local anecdotal information, it was apparently dug by developers in the early-to-mid 1960s and was never used. It is apparent that the lagoon was dug entirely from the native tidal marsh. The lagoon consists of a roughly key-shaped east-west channel, with one small half-round side branch that is connected to the main channel by an area of (undredged) shallow water.

It is important to note that this site is occasionally used by anglers and hunters. During the field studies and other visits, several anglers were observed fishing in the Bay adjacent to the site. A dirt road leads from Bayview Avenue through the site; a side-branch leads down to the Bay, where small boats can be launched from the end of the road. Additionally, several hunting blinds (apparently for duck hunting) were present along the Bay to the southwest of the site. The site has also been used in the past for illegal dumping. Because of its relative remoteness (access is not easy by vehicles, because of protruding trees and shrubs), many demolition materials (bricks, roofing shingles, concrete, etc.) have been dumped along both sides of the dirt road.



When the lagoon was dug, the excavated materials were deposited in a large rectangular-shaped area along the northern boundary of the site, and in two elongated areas on the east and west sides of the dirt road. The tallest pile is located near the south-central boundary of the site (at the southern terminus of the dirt road). Essentially, all of the upland vegetation at the site, as well as the road, exist on fill extracted from the lagoon (refer to Vegetation and Land Cover, below). The channels of the lagoon were cut to an average depth of approximately 13 feet (see results of bathymetric survey, below).

Because of the nature of the potential project at this site, the fill areas were not measured. The dirt road, however, was measured in several places; it is an average of 35 feet wide, and an average of 3 to 5 vertical feet above the existing adjacent marsh. The steep fill pile at the terminus of the dirt road varies from about 15 to 18 vertical feet above the existing marsh; it is about 250 feet long and 100 feet wide. The fill areas and road are composed of a sand-silt mixture.

LAC02A. View looking northwest across the abandoned lagoon at LAC02, at the scrubby upland deciduous forest on the north side of the site (immediately north of these trees is Bayview Avenue). This location is at the "notch" area near the eastern end of the lagoon. The photo was shot directly off the existing dirt access road.

LAC02B. View looking southwest from the existing dirt access road, about midway through the LAC02 site. Vegetation on both sides of the road is scrubby upland deciduous forest.

LAC02C. View looking west across the LAC02 lagoon, from the “notch” area. Note the abrupt, steep sides of the lagoon berms, where scrubby upland forest is present.

4.15.2 Vegetation and Land Cover

The primary vegetation type on the site as mapped is tidal marsh (area 4, Figure 4-15). This large area of tidal marsh was included as part of the site so that it could be properly accounted for and protected during future restoration efforts. The tidal marsh is relatively undisturbed, and its principal species are salt marsh cordgrass (*Spartina alterniflora*), salt hay (*Spartina patens*), marsh spike grass (*Distichlis spicata*), and a small amount of high tide bush (*Iva frutescens*). In addition, seven parcels within the marsh in the western part of the site are dominated by phragmites. From observations during the field studies it is apparent that these parcels may be the result of several inches of fill in these areas (just enough to isolate them from the saline tide).

Most of the areas of fill on the site possess a cover of scrubby, upland deciduous forest (areas 2, Figure 4-15). The forest is characterized by locally dense areas of small trees and shrubs; other areas are open and less dense. The largest trees present are red maple (*Acer rubrum*), and black cherry (*Prunus serotina*); these are scattered, and are a maximum of about 8 inches diameter at breast height (dbh). The average size of the trees on site is about 4 to 6 inches dbh. Other tree species in the forest include American holly (*Ilex opaca*), sassafras (*Sasafrass albidum*) and white mulberry (*Morus alba*). Shrubs and woody vines observed include smooth sumac (*Rhus glabra*), staghorn sumac (*Rhus typhina*), bayberry (*Myrica pensylvanica*), Virginia creeper (*Parthenocissus quinquefolia*), poison ivy (*Toxicodendron radicans*), and Japanese honeysuckle (*Lonicera japonica*).

Other parts of the site possess dense, monotypic covers of phragmites in wetlands (areas 3). Most of these parcels contain only small amounts of fill and are wetlands, but appear to be isolated from the tide. One small area of phragmites on uplands (area 6) is located immediately west of the intersection of the dirt road with Bayview Avenue.

4.15.3 Water Quality

Surface water quality was measured at several depths in five locations on and immediately off the LAC02 site (refer to Section 1 for a description of the equipment used); Table 4-15 presents results. Several items were of note in the lagoon. First, the salinity is moderate, at about 12 to 13 parts per thousand. Second, the dissolved oxygen levels were very low at depths below the surface layer, probably owing to the depth and the very poor flushing that exists in this lagoon. At an average of only about 2 milligrams per liter (lowest readings at 1.69 mg/L), the lower levels of the lagoon likely do not provide a habitat suitable for many biota. Temperatures were also somewhat cold at depth in the lagoon.

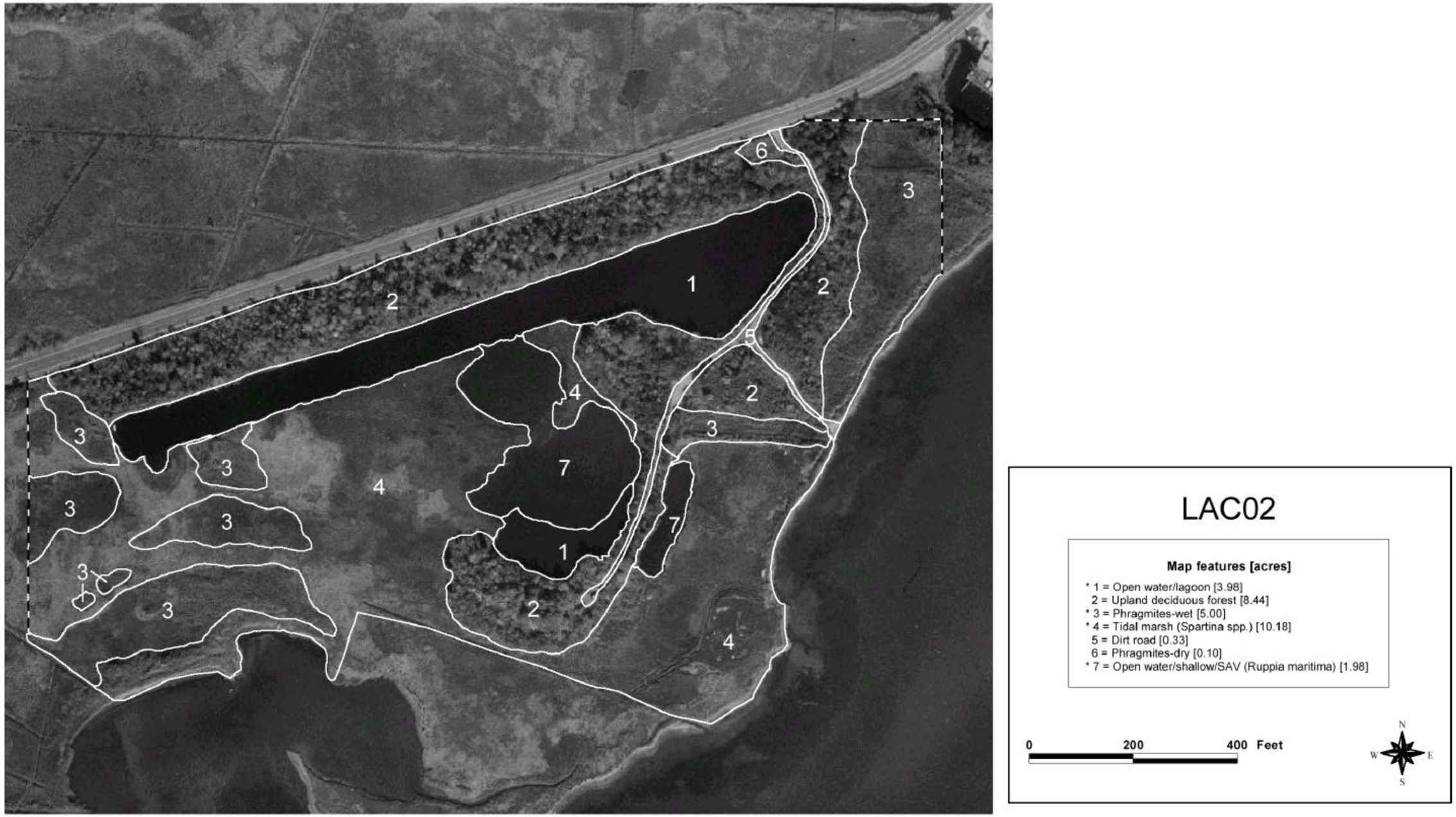


Figure 4-15. Vegetation and land cover of site LAC02. Features were drawn in the field directly onto recent low-altitude, black and white, digitally rectified aerial photographs (USACE 1998). Wetlands vegetation and land cover types are indicated by an asterisk (*) in the legend.

Table 4-15. Results of water quality testing done at Site LAC02 for the Barnegat Environmental Testing field studies. Refer to Appendix B for 24-hour data from this site.

Sampling Location	pH	Salinity (o/oo)	D.O. (mg/L)	Specific Conductivity (mS/cm)	Temp (°C)	Turbidity (NTU)
W1A (SE end of lagoon; surface)	7.42	12.85	7.59	21.49	27.7	22.5
W1B (SE end of lagoon; 2.3 meters)	7.31	12.51	2.24	20.81	19.51	24.1
W2 (middle of lagoon; 3.79 meters)	6.89	13.31	1.69	22.03	15.56	135.2
W3A (W end of lagoon; surface)	7.31	12.87	6.96	20.90	27.01	22.7
W3B (W end of lagoon; 3.17 meters)	7.23	12.93	1.90	21.46	17.69	24.3
W4 (B. Bay, immed. east of site; 0.32 meter)	8.07	23.59	7.86	37.38	28.83	97.4
W5 (small pond, E of dirt road; 0.63 meter)	7.62	16.25	6.60	26.70	30.33	21.4

4.15.4 Bathymetric Survey

A simplified bathymetric survey was performed to determine the approximate depths, bottom contours, and substrate of LAC02. Ten stations were evenly distributed throughout the lagoon (middle and sides); all stations were sampled for depth and dominant substrate. Detailed notes were also made at each station, where appropriate. The results of the bathymetric survey are presented in Table 4-16. The lagoon possesses shallow shelves for approximately the first 10 horizontal feet and then drops precipitously into a U-shaped trough as deep as 17 feet. From the results it is apparent that the lagoon is an average of about 13 feet deep in the middle, and the shallow shelves on the sides are about 4.0 feet deep. The substrate in all areas and depths was a black, hypoxic, foul-smelling, fine silt.

Table 4-16. Results of bathymetric survey performed at site LAC02 for Barnegat Environmental Testing.

Station #	Water depth (feet)	Substrate	Notes
A	15.3	fine silt	black, odorous muck
B	8.0	fine silt	black, odorous muck
C	1.5	fine silt	black, odorous muck
D	12.0	fine silt	black, odorous muck
E	1.5	fine silt	black, odorous muck
F	13.0	fine silt	black, odorous muck
G	12.2	fine silt	black, odorous muck
H	14.3	fine silt	black, odorous muck
I	12.3	fine silt	black, odorous muck
J	16.3	fine silt	black, odorous muck

4.15.5 Wildlife

Seining was performed in two locations to assess the fish population of the lagoon portion of LAC02. The seine used was a 75-foot-long, 8-foot-wide net; seining was done in shallow shelves off the northern-most part of area 7 where it meets area 1 (see Figure 4-13), and at the southwestern end of the lagoon. Abundant juvenile fish were captured with the seine. It must be noted, however, that these fish were caught only on the shallow shelves at the edges of the deep water.

Table 4-17. Combined results of seining in shallow shelf areas in two locations at site LAC02, on 27 June 2000. Seining was not performed in the deep waters of LAC02. Refer to text for sampling locations.

Scientific Name	Common Name	Notes
Fundulus heteroclitus	Mummichog	abundant (>100 total)
Fundulus majalis	Striped killifish	abundant
Menidia menidia	Atlantic silverside	abundant
Cyprinodon variegatus	Sheepshead minnow	several
Apeltes quadracus	Fourspine stickleback	several
Gobiosoma bosc	Naked goby	one individual
Callinectes sapidus	Blue crab	five small juveniles and several large adults
Palaemonetes pugio	Grass shrimp	abundant

Other wildlife and their signs (tracks, scats, calls, and other identifiable physical evidence) observed at the site while conducting the field studies were all birds, including sharp-tailed sparrow (*Ammospiza caudacuta*), marsh wren (*Cistothorus palustris*), American egret (*Casmerodius albus*), and snowy egret (*Egretta thula*). Most of the birds were observed along the southern and western boundaries of the site, adjacent to the existing tidal marsh, and not in its interior. Because of the lower salinity relative to that of the adjacent Bay, and the presence of SAV, it is possible that the shallow areas of the lagoon (i.e., area 7) could be occasionally used by aquatic birds (e.g., ducks and geese) for resting and feeding. No birds were actually observed, however, during several late fall and early winter visits to the site. Because of the relatively small size of the lagoon

(less than 4 acres) and the fact that SAV only occurs within area 7 (less than 2 acres), it is unlikely that this is a significant resource for aquatic birds. It should also be noted that no signs of diamondback terrapins were observed anywhere on or adjacent to the site. This may be owing to the fact that the site is isolated from the tide and no appropriate habitats (i.e., open or semi-open and sandy) are present.

4.15.6 Environmental Problems at the Site

Loss of Habitat from Dredging and Filling

The open water parts of the site (areas 1 and 7), totalling 5.96 acres, were almost certainly excavated directly from the native tidal marsh, resulting in a direct loss of ecologically valuable wetlands. Almost 14 acres of tidal marsh were also filled with materials excavated during the lagoon excavation. The lagoon was probably excavated prior to federal or state wetlands legislation (i.e., Federal Clean Water Act and the New Jersey Tidal Wetlands Act).

Degradation of Water Quality

Abandoned lagoons such as LAC02 add to the deterioration of local water quality in the Bay. This is primarily because they are generally deep, poorly-flushed environments where dissolved oxygen is low. LAC02 possesses particularly poor water quality.

4.15.7 Restoration Constraints and Other Site Information

Although there is some public use of LAC02, it seems likely that restoration could be performed at the site with no change in current uses (with the exception of trash dumping). Access to fishing on the Bay would still be possible via the same dirt road, and the hunting blinds to the southwest would remain accessible. Further, it is possible that the deep water habitats of the lagoon could be restored to improve the existing fishery, potentially providing additional opportunities for local anglers.

Another potential constraint is that LAC02 is located directly adjacent to tidal marsh habitats to the south. Access during restoration, however, could be over the existing upland dirt road; in this case, no tidal marshes would be disturbed.

No aspects of the restoration will adversely affect the existing submerged aquatic vegetation within area 7 at LAC02. On the contrary, it is possible that additional areas of SAV could be created within what are now deep water habitats in the lagoon.

4.15.8 Restoration Concept

The concepts for restoration at LAC02 include improvements for fishery resources, particularly for juvenile fish, benthos, and for creation of additional SAV habitats. Other, more minor (but still important) benefits will also be realized as a part of

the restoration. These will include improved water quality (as a result of better water circulation) and phragmites removal.

It is important to note that the juvenile fish caught during the seining primarily inhabit the shallow shelf areas prior to the deep drop-off of the lagoon. It is presumed that because of the deep, cold, hypoxic conditions of the bottom substrate (black muck), juvenile fish and benthos prefer to inhabit the shelves. This condition likely renders the majority of the bottom lagoon habitat useless to fish and benthos. It is therefore recommended that the deep, uniform U-shaped trough parts of the lagoon be raised to shallower depths to provide a more oxygenated, varied environment that is conducive for both fish and benthos. The bottom contours of the lagoon would be made variable, but would be an average of about 10 feet to maximize habitats for a number of species. There is also a small area immediately south of the open shallow water (area 7) that is open, deep water (similar to the main channel lagoon). Because this deep area is adjacent to the shallow water that possesses abundant SAV, it would be appropriate to fill this hole to approximately the existing depth of the substrate in the shallow water area. It is estimated that the SAV would colonize the area without re-planting. Materials that could be used for fill exist adjacent to the dirt road, particularly in the large pile at its terminus (in fact, these upland areas exist as a result of material being excavated from the marsh; returning a portion of the materials as a restoration technique makes sense logically).

Other areas of the scrubby deciduous forest habitats at the site (8.4 acres total) would be preserved intact as habitats for wildlife. They would be allowed to mature through natural ecological succession. It should be noted that although such upland forested habitats were not originally native to the site (nor even the direct vicinity of the site), they provide a small amount of marginal habitat for wildlife such as songbirds.

4.15.9 Project Implementation

Two channels would be cut to improve circulation in the lagoon, one in the northeast, and another in the southeast. The northeast channel would be culverted; it would be dug through the eastern branch of the existing dirt road, from its terminus at the Bay and then north to the lagoon, a total distance of 300 feet. The channel would be made 30 feet wide and approximately 12 feet deep. The excavated material would have to be stockpiled in adjacent uplands or temporarily stored off-site. A series of three 10-foot diameter corrugated metal pipes would then be installed in the channel, and it would be back-filled with about 2 feet of material to restore the road. Some rip-rap or other anti-erosion materials (such as a concrete sill) would likely be required at the terminal ends of the pipes to prevent erosion. The system would be passive and would not require flap gates or other structures. Based on these figures, approximately 4,000 cubic yards of material would have to be excavated, stored temporarily, and then re-applied. The approximately 3,333 cubic yards of excess material could be used as fill material for the bottom-raising of the lagoon (see below).

The southeast channel would not be culverted. It would be cut from the southwestern end of the lagoon to the south through three large areas of phragmites and

into the Bay (see Figure 4-15). The total length of the channel would be approximately 420 feet. For proper circulation, the channel would also be a minimum of about 10 feet wide and 2 feet deep. Keeping the channel to a maximum 10-foot width would also minimize impacts to the existing tidal wetlands. All three parcels of phragmites exist on fill that appears to be only several inches above the surrounding tidal marsh. At about 2 feet deep, the channel would be at an elevation that would flood portions of all three parcels of the phragmites at high tide (killing the phragmites with the high salinity Bay water). Both ends of the channel would be re-vegetated after construction, and would not require structures or rip-rap. Based on these figures, approximately 311 cubic yards of material would have to be excavated; it must be removed from the wetlands, but could be used as fill material for the bottom-raising of the lagoon (see below). Depending on the machinery used, bog mats or other protective devices may be necessary to protect the existing tidal wetlands during the channel cutting. The equipment could be brought in by barge on the Bay side or from Bayview Avenue, through the scrubby upland forest, and across the lagoon.

To raise the bottom of the lagoon to an average of 10 feet, sandy, excavated material would have to be added. By applying the information from the bathymetric survey and direct measurement of the aerial photograph, this volume can be calculated. The lagoon is essentially a large rectangle with a notch in its eastern end. Not including the notch, the lagoon is 1,500 feet long, 80 feet wide, and an average of 13 feet deep. The notch is approximately 400 feet long, an average of 70 feet wide, and an average of 13 deep. Not including the side shelves (which are10 feet wide on both sides and shallower) the main branch of the lagoon is essentially a U-shaped trough. The calculation for materials to fill the trough to an average of 10 feet would be 1,500 feet X 80 feet X 3 feet = 360,000 cubic feet = 13,333 cubic yards. A similar calculation can be applied for the notch section (eastern end) of the lagoon. For the notch, it is 400 feet X 70 feet X 3 feet = 84,000 cubic feet = 3,111 cubic yards. The total amount of fill to raise the lagoon to an average of 10 feet would be 13,333 + 3,111 = 16,444 cubic yards. If sandy materials from both of the channel cuttings were used in the bottom-raising, the total materials required for the main lagoon would be 16,444 – 3,644 = 12,800 cubic yards. If all 3,333 cubic yards of excess material from the northeast channel cutting were subtracted from this, the total materials required would be 12,800 – 3,333 = 9,467 cubic yards.

In addition, the small area of deep open water to the immediate south of the large shallow open water area is an average of 175 feet long, 100 feet wide, and 10 feet deep. The calculation for materials to fill this trough to an average of 1.5 feet (approximate depth of substrate where existing SAV grows) would be 175 feet X 100 feet X 8.5 feet = 148,750 cubic feet = 5,509 cubic yards. This, added to the other materials required for bottom-raising, would be 5,509 + 9,467 = 14,976 cubic yards.

To put the amount of fill required in perspective (based on the measurements defined under Site Description, above), the large fill pile at the southern terminus of the dirt road contains an estimated 16,667 cubic yards of materials. Using only part of this pile would provide enough materials for the project.

Equipment for materials excavation could probably be brought in over the existing dirt road with little or no upgrades. The materials excavation would then proceed from the southern terminus of the dirt road. Excavation of the small area of fill north of the lagoon could use access from Bayview Avenue.

Monitoring and maintenance of the restored LAC02 site will require long-term (but not necessarily complex) studies of the lagoon fishery and the restored SAV area, to ensure their effectiveness and success.

4.15.10 Potential Environmental Impacts

The northeastern channel would pose very little or no impact to existing wetlands, as it would be constructed entirely in uplands. A small amount of rip-rap or other materials may be used on both the Bay and lagoon sides of the channel, but this would cover a very small area (and may be within uplands). Excavated materials would be stored in uplands or off the site (not in wetlands). After construction of the channel the pipes would be installed, and the channel would be capped with part of the excavated material. With the use of appropriate best management practices and soil erosion and sediment control measures, this aspect of the restoration would pose no adverse effects.

The southeastern channel would be constructed through a mixture of phragmites marsh (primarily) and tidal marsh. As a rough estimate based on the mapping presented in Figure 4-15, and assuming a 10-foot-wide channel, this would involve conversion of 0.07 acre of phragmites marsh and 0.02 acre of tidal marsh to tidal open water (channel). Creation of the channel would have the added benefit of partial phragmites removal in the three existing areas of phragmites, because they would be exposed to saline Bay water from the tide. Because the material excavated from the channel would be completely removed, and because the salinity of the Bay water it would be introducing is high (similar to that of ocean water), it is extremely unlikely that phragmites would become established along the channel. Because of its very small size and depth, it is also unlikely that the channel would have any significant effect on surrounding tidal wetlands. To put the proposed channel-cutting in perspective, many of the existing tidal wetlands in the vicinity of the site have been historically grid-ditched by the County Mosquito Commission; most of these tidal wetlands exhibit cordgrass-dominated communities. Many of the historic ditches are larger than the one proposed.

Elements of the proposed restoration would result in a loss of on-site scrubby upland forest habitat (within areas 2). This upland habitat would be lost from most of the large pile at the southern terminus of the dirt road, and within the large rectangular area of fill north of the lagoon, totaling about 0.9 acre. However, no mature trees exist on any of these fill piles, and the vegetation is sparse and scrubby throughout. Many of the predominant vegetative species are introduced invasives. These habitats are not originally native of the site and are a direct result of tidal wetland destruction when the lagoon was dug. The berms, however, probably provide a small amount of habitat for songbirds and other wildlife. It is proposed, therefore, to preserve the remaining upland habitats as they exist.

Creation of new SAV habitat from the existing small parcel of deep water below area 7 is not expected to impact existing SAV habitats. It is envisioned that fill materials for this aspect of the restoration will come from the large fill pile immediately adjacent, at the southern terminus of the dirt road. All of the fill work will be performed from the existing uplands. With the use of appropriate best management practices and soil erosion and sediment control measures, this aspect of the restoration would pose no adverse effects.

Overall, with implementation of appropriate soil erosion and sediment control measures, the proposed activities, including creation of the channels, bottom-raising of the lagoon, and creation of new SAV habitat would pose minimal impacts on ecological resources. Such measures could include use of silt curtains, hay bales, temporary seeding of steep exposed slopes, etc.

Implementation of the project would not likely result in any additional significant positive or negative impacts relating to air quality and noise levels, water quality, wetlands and other special aquatic areas, finfish, including Essential Fish Habitat, wildlife resources including, but not limited to, the target species that have been identified, and threatened and endangered species.

4.15.11 Estimated Costs

The following approximate estimated costs relate to the principal elements of the project implementation at site LAC02, as stated above. The costs listed are approximate only, subject to change, and are primarily intended to provide perspective of the relative magnitude of the project. It must also be noted that where a range of costs for each item was available, the maximum cost was used.

Northeast channel cutting:
4,000 cubic yards @ $35.00 per c.y. = $140,000

Southeast channel cutting:
311 cubic yards @ $35.00 per c.y. = $10,885

Material excavation from berms/deposition in lagoon:
9.467 cubic yards @ $35.00 per c.y. = $331,345

Material excavation from berms/deposition for SAV habitat:
5,509 cubic yards @ $35.00 per c.y. = $192,815

Vegetation clearing:
$500 per day X 5 days = $2,500

Monitoring and maintenance:
Site inspections and monitoring: $800.00 X 6 visits = $4,800.00

GRAND TOTAL = $682,345

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4.16 SITE ISS03 (HIGH ISLAND)

4.16.1 Site Description and Ownership

Site ISS03 (High Island) is privately owned by the Brant Beach Yacht Club. It is located in Barnegat Bay, approximately 1,750 feet west of the community of Brant Beach on Long Beach Island. The site is roughly triangular in shape (widest northwest to southeast), and is a total of approximately 11 acres. The site has been used for the disposal of dredged material within the past 20 years; no berms, however, were noted on the site. ISS03 is highest in elevation on its northwestern side, where an open area of sand and grasses (area 1, Figure 4-16) is present. An adjacent area containing small red cedar trees and bayberry (area 4) is of only slightly lower elevation; the same is true for area 3 in the northern part of the site. The lowest elevations at the site are in the tidal marsh that encircles the entire perimeter of the site in a narrow band (area 6).

Substrate corings taken throughout the site and other measurements indicate that the fill in the highest part of the site (area 1) is an average of about 6 to 8 feet above the tidal marsh encircling the site; the substrate in this area consists of fine sand with many shells. The adjacent area 4, as well as area 3, are an average of about 5 feet above the tidal marsh; both areas consist of medium sand. The remainder of the site (with the exception of the tidal marsh) is an average of about 4 feet above the site undisturbed marsh. Groundwater was not intercepted in any of the substrate corings (refer to data sheet, Appendix B).

ISS03A. View looking southwest from the highest point on High Island (area 1). The open, sandy area is dominated by downy brome, an introduced, invasive grass. Shrubs and woody vines visible in the photo include bayberry, smooth sumac, winged sumac, rugosa rose, and poison ivy.

ISS03B. Detail view of what the majority of the existing vegetation at ISS03 looks like. The dense, nearly monotypic phragmites on uplands also occasionally contains field bindweed, pokeweed, and poison ivy.

ISS03C. View looking southeast at the narrow margin of tidal marsh along the southwestern side of the island. Note the short, weak phragmites at the edge of the marsh where the fill material is thin and its rhizomes are exposed to the saline tide.

4.16.2 Vegetation and Land Cover

The primary vegetation type at site ISS03 (High Island) is upland phragmites (area 5, Figure 4-16). The upland phragmites is generally monotypic (*Phragmites australis*), but it also contains occasional dense patches of pokeweed (*Phytolacca americana*), field bindweed (*Convolvulus arvensis*), poison ivy (*Toxicodendron radicans*), and an unidentified blackberry (*Rubus* sp.). Several variations of the upland phragmites type are four small parcels (areas 2) containing an approximately even mixture of phragmites and high tide bush (*Iva frutescens*). Two small (less than 1 acre) parcels containing deciduous trees and shrubs on the site are a scrubby red cedar-dominated (*Juniperus virginiana*) community (area 4, in the northwest) and a bayberry-dominated (*Myrica pensylvanica*) community (area 3, in the northeast). The red cedar community also possesses poison ivy, blackberry, bayberry, Virginia creeper (*Parthenocissus virginiana*), rugosa rose (*Rosa rugosa*), and phragmites as its co-dominant vegetation. Most of the red cedar trees in this parcel are small and are less than about 5 inches dbh. The bayberry community also possesses sassafras (*Sassafras albidum*), smooth sumac (*Rhus glabra*), winged sumac (*Rhus aromatica*), poison ivy, phragmites, and Virginia creeper as its co-dominant vegetation. Some of the bayberry shrubs in this parcel are relatively large. Vegetation on the high point consists of a mixture of open sand and grasses. The principal species here is downy brome (*Bromus tectorum*); also present are rugosa rose and pokeweed. The tidal marsh at the site is dominated by salt marsh cordgrass (*Spartina alterniflora*); some perennial glasswort (*Sarcocornia perennis*), phragmites, and high tide bush are also present.

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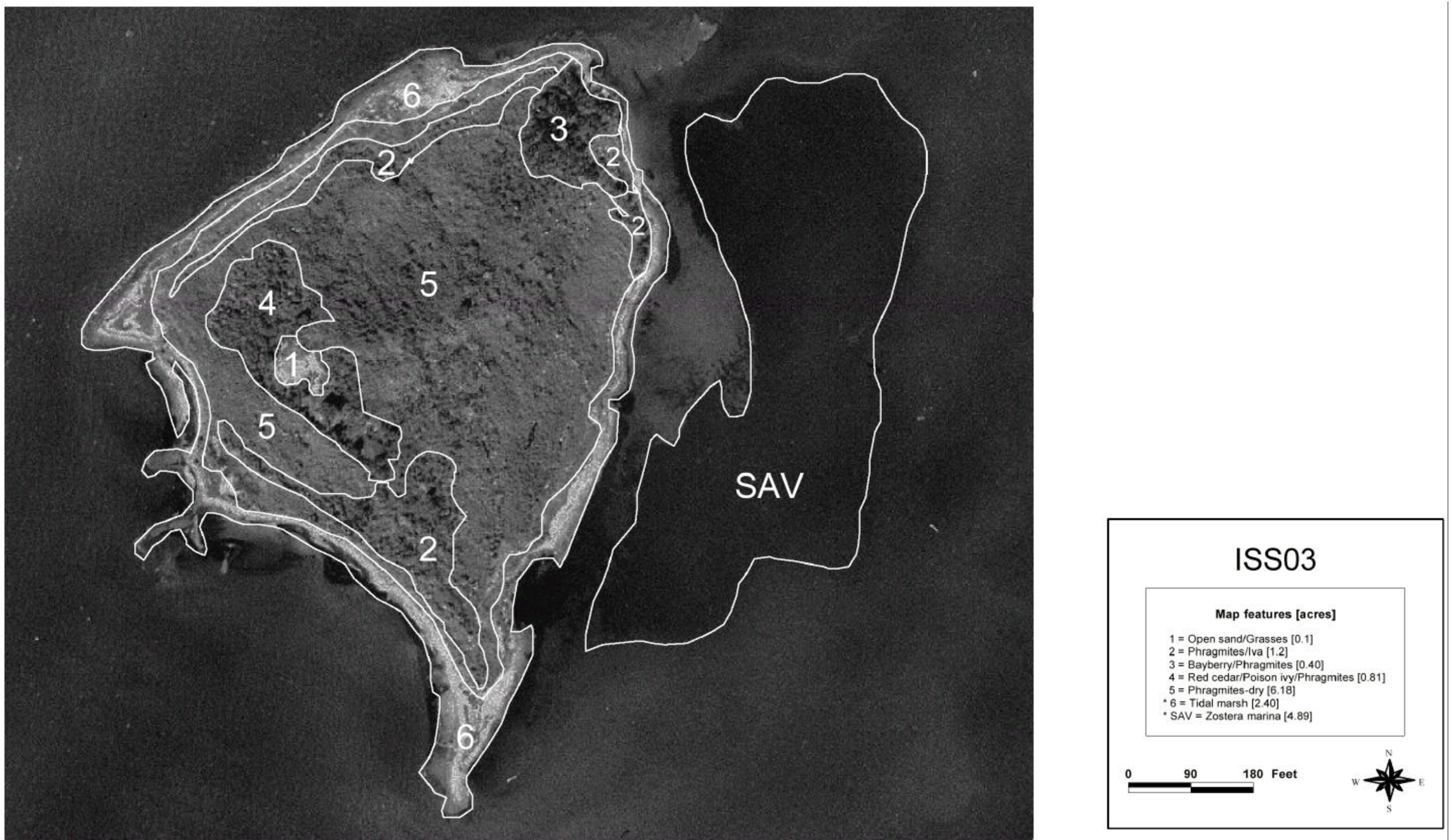

Figure 4-16. Vegetation and land cover of site ISS03. Features were drawn in the field directly onto recent low-altitude, black and white, digitally rectified aerial photographs (USACE 1998). Wetlands vegetation and land cover types are indicated by an asterisk (*) in the legend.

A large parcel of submerged aquatic vegetation (SAV) was also mapped directly to the east of High Island. The parcel contained only eelgrass (*Zostera marina*). Although the visibility through the water in this area was poor, it was determined that the eelgrass in this parcel appeared to be relatively healthy, and was dense to very dense. No other areas of SAV were located in the vicinity of High Island.

4.16.3 Water Quality

Surface water quality was not measured at site ISS03 because no surface water features exist at the site.

4.16.4 Wildlife

Wildlife and their signs (tracks, scats, calls, and other identifiable physical evidence) observed at the site while conducting the field studies included red fox (*Vulpes vulpes*), great egret (*Casmerodius albus*), little blue heron (*Florida caerulea*), boat-tailed grackle (*Quiscalus major*), and willow flycatcher (*Empidonax trailii*). Several red fox dens (apparently not current) were noted on the high point (area 1) of the island. It is not known whether the foxes are permanent or transient residents on the island, or how they got there. It was interesting to note that red foxes were found in similar situations (i.e., high points of island, open sandy areas, etc.) at all of the island sites studied. Because of the density of the vegetation on all other parts of High Island, it is not likely that the foxes use other areas for denning. Several great egrets and boat-tailed grackles were observed feeding and loafing along the tidal marsh in the western part of the site. The little blue heron was observed perched near the high point of the island; no nest was located. Despite the presence of the small areas of woody vegetation at both ends of the island, no nests of long-legged wading birds (i.e., colonial nesters) were observed. It is likely that the vegetation is too dense in these areas; many of the trees are covered with Virginia creeper and poison ivy vines. Both of these areas are also very small (combined, just over 1 acre). Additionally, the presence of predators such as foxes (and occasionally, humans) may also deter nesting of these birds at the site. The willow flycatcher was also observed perched and singing on a shrub near the high point of the site; it may be breeding here.

4.16.5 Environmental Problems at the Site

<u>Loss of Habitat from Dredging and Filling</u>

It is not currently certain whether dredged materials were originally placed in tidal marsh, uplands, or open water (or a combination of these). It is most likely, though, that the fill was placed directly on tidal marsh. If this were the case, the 2.4 acres of existing tidal marsh could be subtracted from the 11 acres total, leaving about 8.6 acres of tidal marsh that were originally affected.

Dominance by Phragmites

Site ISS03 is dominated by a dense stand of phragmites on uplands (area 5), along with several other communities where phragmites is also co-dominant (areas 2, 3, and 4). It is relatively dense and firmly established, particularly in area 5, but will not likely spread further owing to either high salinity (area 6) or shading from woody vegetation (areas 2, 3, and 4).

4.16.6 Restoration Constraints and Other Site Information

The New Jersey Natural Heritage database indicates that records exist for four species of concern, including snowy egret (*Egretta thula*), black-crowned night heron (*Nycticorax nycticorax*), glossy ibis (*Plegadis falcinellus*), and gull-billed tern (*Sterna nilotica*) at High Island. The first three species were part of a minor coastal heron rookery that took place on the island in 1983 (it is assumed that the rookery was abandoned after 1983). A pair of gull-billed terns also nested on the island in 1985. Both breeding and non-breeding populations of snowy egrets are state listed as stable and not undergoing any long-term increases or decreases. Breeding populations of black-crowned night heron are state listed as Threatened; non-breeding populations are stable. Breeding populations of glossy ibis are state listed as declining; non-breeding populations are stable. Both breeding and non-breeding populations of gull-billed terns are state listed as stable, but future breeding populations may be critically imperiled. Populations of all four of these species are considered to be very stable throughout their natural habitats. Because all of the existing areas of woody vegetation would be preserved under the proposed restoration plan, no negative effects to its potential use as a coastal rookery by the four listed species (and others) are anticipated. It is estimated, however, that the site would never support a major coastal heron rookery because of its proximity to land and the intracoastal waterway, and because of its relatively small size (and lack of suitable woody vegetation).

The ISS03 site is also part of an area designated by NJDEP Heritage as the Manahawkin Bay Macrosite, a Natural Heritage Priority Site. According to Heritage, the macrosite contains a large stretch of back bay and salt marsh islands, providing habitat to many rare colonial waterbirds (many are state listed species).

As indicated above, the site is privately-owned, and potential future use of the island for dredged material disposal is not known. The site is apparently used on an as-needed basis by the owners as minor dredging projects are required (e.g., to improve navigation in lagoon community waterways) in the vicinity of Brant Beach (personal communication, Bill Dixon, NJDEP). It may be possible to restore all or only parts of the island, depending on projected future needs by the owner.

"Aquatic Pesticide Permits," issued by NJDEP, Pesticide Control Program would be required for all the large-scale herbicide applications in the Barnegat projects. The spray permits are typically issued under a pesticide license maintained by the pilot or airport supplying the aircraft (personal communication, Eric Schrading, USFWS). In

addition, the prescribed burning recommended at this site would also likely require a permit from the New Jersey Forest Fire Service.

Submerged aquatic vegetation was observed in a large 4.89-acre parcel directly to the east of the island. The parcel was noted to contain only eelgrass; the eelgrass was dense to very dense and appeared healthy. This large SAV bed must be avoided and strictly protected during any restoration efforts at High Island.

4.16.7 Restoration Concept

The restoration concept at ISS03 would be to establish approximately 7.3 acres (area 5 = 6.18 acres; areas 2 = 1.2 acres) of open, sandy habitats for use by beach-nesting birds (e.g., terns and skimmers) and diamondback terrapins; the two small existing areas containing woody plants (area 4 and area 3) would be preserved for other wildlife such as songbirds. Existing tidal marsh (area 6) would also be preserved intact. The open, sandy habitats would be created in the upland phragmites-dominated habitats of areas 5 and 2. These habitats would mimic the small open, sandy area near the top of the island, but would be maintained as open and essentially unvegetated. Such habitats could be viewed as "temporary," in that they would be allowed to naturally re-vegetate; "maintenance" could consist of deposition of new materials in the areas every 3 to 5 years, depending on disposal needs. Based on results of similar restoration of other area sites, natural re-vegetation would probably be slow enough to allow active use of the site by beach-nesting birds for at least 3 years, and by diamondback terrapins for at least 5 years (personal communication, David Jenkins, NJDEP).

The existing phragmites in area 5 and areas 2 must be eradicated prior to placement of the sandy fill at the site. Eradication would best be accomplished by aerial spraying of an herbicide agent containing glyphosate that is EPA-registered for use in aquatic and semi-aquatic environments.

4.16.8 Project Implementation

Area 5 is currently about 4 feet above the existing tidal marsh. To raise area 5 (6.18 acres) and areas 2 (1.2 acres) to approximately the elevation of the island high point (area 1; about 6 to 8 feet about the marsh) would require addition of about 3 vertical feet overall. To calculate this quantity, 7.3 acres = 317, 988 ft^2 X 3 vertical feet = 953,964 cubic feet = 35,332 cubic yards of clean, sandy material would have to be applied over this area. The materials could be added to the site using a small bulldozer, backhoe, or similar piece of equipment, and would be graded as flat as possible over the area. Equipment would likely have to be brought in by barge or similar craft to the site along its northeastern end, through part of area 3. Gaining access from this part of the site would likely minimize damage to the existing tidal marsh, as it is narrowest in this area. Fill addition and spreading would then proceed generally from southwest to northeast. The equipment could be brought in over bog mats or similar structures to help protect this narrow area of tidal marsh from excessive compaction. Access to the site by equipment must be limited to one point to minimize impacts to the existing tidal marsh.

Phragmites eradication would take place at the end of the growing season prior to the material deposition. For the best effect of the glyphosate herbicide, spraying of the phragmites would take place from early to mid-September. This is because the best effect of the herbicide is achieved when transport of the photosynthesized sugars from the leaves of the plants to its rhizomes is maximized, reportedly during this time of year. Because of the open nature of the site, spraying could be accomplished either by fixed-wing craft or by helicopter (costs may be significantly lower by fixed-wing craft). For best success of removal, all phragmites eradication would be performed at one time (or on successive days). Proper care must be taken to closely follow all manufacturer application and safety guidelines, particularly regarding appropriate wind and climatological conditions. The dead phragmites stands would then be control-burned in the winter to remove dead standing canes (winter burning maximizes the number of dead phragmites canes), and to enhance the success of follow-up herbicide treatments. It is recommended that follow-up aerial herbicide and burning treatments be made with the same timing (i.e, early fall herbicide treatment and winter burning) over at least three successive years. In addition, site inspections must be made beginning in late spring after the first aerial application to monitor the success of the phragmites eradication. Persistent problem areas after several treatments must be noted; these (smaller) areas would be hand-sprayed with backpack sprayers or similar devices.

Monitoring and maintenance of the site will involve a semi-annual inspection over at least three consecutive years to monitor the created habitats for success of phragmites eradication and use of the site by beach-nesting birds and diamondback terrapins.

4.16.9 Potential Environmental Impacts

It is estimated that environmental impacts resulting from implementation of the project will be restricted to a small temporary loss of tidal marsh vegetation in the wetlands bordering the site, owing to the phragmites eradication. Herbicides containing glyphosate are non-selective, and will slowly kill virtually all vegetation that they contact. Such losses will be minimized with the selection and use of the most appropriate spray equipment (e.g., spray nozzles, booms, etc.) and their use during optimal atmospheric conditions. Applied correctly in the appropriate concentrations, the herbicide is not anticipated to cause any negative effects to existing invertebrates, fish, and wildlife currently using the sites. Appropriate use of erosion and sediment control measures (e.g., silt fences, temporary berms, biologs, etc.) would minimize sedimentation impacts to the adjacent tidal marsh and other sensitive areas during the construction work.

Implementation of the project would not likely result in any additional significant positive or negative impacts relating to air quality and noise levels, water quality, wetlands and other special aquatic areas, finfish, including Essential Fish Habitat, wildlife resources including, but not limited to, the target species that have been identified, and threatened and endangered species.

4.16.10 Estimated Costs

The following approximate estimated costs relate to the principal elements of the project implementation at site ISS03, as stated above, assuming the project is not conducted in conjunction with other restoration projects. The costs listed are approximate only, subject to change, and are primarily intended to provide perspective of the relative magnitude of the project. It must also be noted that where a range of costs for each item was available, the maximum cost was used.

Sandy material disposal/transportation/spreading:
35,332 cubic yards @ $35.00 per c.y. = $1,236,620

Phragmites eradication:
Aerial herbicide: 7.3 acres @ $79.00 per acre = $577.00 X 3 treatments = $1,731.00
Controlled burn: $800.00 X 1 visit = $800.00

Monitoring and maintenance:
Phragmites mapping/bird monitoring/backpack spraying: $800.00 X 6 visits = $4,800.00

GRAND TOTAL = $1,243,951

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4.17 SITE ISS01 (CEDAR BONNET ISLAND)

4.17.1 Site Description and Ownership

Site ISS01 (Cedar Bonnet Island) is owned by the USFWS and is included within the Edwin B. Forsythe Refuge system. It is located immediately south of the Route 72 bridge, approximately 0.5 mile west of Ship Bottom. The ISS01 site comprises only a part of the Cedar Bonnet Island system; specifically, this is the portion used for dredged material disposal, south of the Route 72 bridge. It may be noted that the site is not an island in the true sense (i.e., completely surrounded by water), as it is totally connected to the Route 72 causeway on its north side; it is really a peninsula. The site has been used for the disposal of dredged material within the past 20 years; it possesses substantial berms in various places. The approximately 143-acre site possesses a complex array of different vegetation and land cover types. The majority of the interior part of the site is all upland that is surrounded by tidal marsh and phragmites wetlands. The two high points on the site are in the south-central and southeastern parts, where open areas of sand, grasses, and scrub are present. The remainder of the island essentially consists of a mixture of scrub, phragmites, and tidal marsh (see Vegetation and Land Cover, below).

Substrate corings taken throughout the site and other measurements indicate that the filled areas of the site are about 7 to 10 vertical feet above the adjacent mean high water in Barnegat Bay. The phragmites marsh areas are approximately 3 vertical feet and less above the adjacent mean high water. The tidal marsh on the site is about 1 vertical foot and less above the adjacent mean high water. The two open, sandy high points are approximately 10 to 12 vertical feet above the adjacent mean high water. Substrate throughout the entire site (with the exception of the undisturbed tidal marsh) consists of medium to coarse sand. Groundwater was intercepted at or near the surface in the substrate corings in the tidal marsh and the phragmites marsh areas; other areas were dry (refer to data sheets, Appendix B).

ISS01A. View looking northwest from near the southeastern corner of the ISS01 site (looking toward a formerly cleared path). The dense vegetation in this location (area 4) is dominated by a mixture of phragmites, bayberry, switchgrass, and poison ivy.

ISS01B. View looking northwest through the southern-most parcel of area 6 (see photo 2). A diamondback terrapin was observed laying eggs in late June 2000, approximately where the scientist is standing. The area appears to be at least occasionally heavily used by diamondback terrapins; it is not currently clear what role the resident foxes play, if any, in limiting hatchling terrapins at the site.

ISS01C. Detail view of active fox den in the southern-most parcel of area 6, a dry, open sandy high spot. Also note the very dense shrubs and woody vines bordering this area, primarily consisting of bayberry and poison ivy.

4.17.2 Vegetation and Land Cover

The primary vegetation type at site ISS01 (Cedar Bonnet Island) is tidal marsh (areas 1, Figure 4-17). Although these areas of tidal marsh were mapped as part of the site, no restoration would be performed in these relatively pristine areas. They were included as part of the site because they may be used as reference areas for creation of additional tidal wetlands in the existing filled areas. The largest areas of tidal marsh at the site exist along the western and southwestern edges. The principal species in the tidal marsh at the site are salt marsh cordgrass (*Spartina alterniflora*) and salt hay (*Spartina patens*); in addition, salt marsh spike grass (*Distichlis spicata*), perennial glasswort (*Sarcocornia perennis*), and common pigmyweed (*Crassula aquatica*) are also locally abundant. The second-most dominant wetland vegetation type is phragmites marsh (area 2). The phragmites marsh is generally monotypic (*Phragmites australis*) throughout, and comprises large areas of the northern and eastern boundaries of the site. The only other species noted frequently in the phragmites marsh was high tide bush (*Iva*

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Figure 4-17. Vegetation and land cover of site ISS01. Features were drawn in the field directly onto recent low-altitude, black and white, digitally rectified aerial photographs (USACE 1998). Wetlands vegetation and land cover types are indicated by an asterisk (*) in the legend.

frutescens), observed primarily along its outer edges. The only other wetlands types at the site are unvegetated shallow open water, composed of three small ponds (one apparently man-made), and one SAV bed along the southeastern edge of the site. The SAV bed consists of a dense, apparently healthy stand of widgeon grass (*Ruppia maritima*).

Several types of upland vegetation associations exist at ISS01. The largest of these is a phragmites/upland scrub association (areas 4) that essentially surrounds the highest points of the site and contains a mixture of herbaceous and shrub species. The principal species in this upland type include phragmites, poison ivy (*Toxicodendron radicans*), bayberry (*Myrica pensylvanica*), winged sumac (*Rhus aromatica*), smooth sumac (*Rhus glabra*), and Virginia creeper (*Parthenocissus quinquefolia*). Poison ivy is locally very dense and tall in some areas of the upland scrub association, making passage in these areas unwise, particularly during the growing season.

The next largest upland vegetation association is a bayberry-dominated upland scrub (areas 5). Also present in the upland scrub is rugosa rose (*Rosa rugosa*), Japanese honeysuckle (*Lonicera japonica*), poison ivy, and phragmites. Small trees, including red maple (*Acer rubrum*), sassafras (*Sassafras albidum*), and cottonwood (*Populus deltoides*) are also scattered throughout the upland, but are very infrequent (average diameter at breast height is about 4 to 6 inches). Another variation on the upland scrub vegetation is dominated by small to medium-sized deciduous trees; it exists in two parcels near the center of the site (areas 8). These two parcels contain mixtures of the same species as in the bayberry scrub, but the trees are clearly dominant and are somewhat larger (average diameter at breast height is about 6 to 10 inches).

The remaining upland type at ISS01 is an open sand/dune scrub association that exists on its two high points (areas 6). The open sand/dune scrub possess an open sand/deciduous scrub vegetation that is dominated by switchgrass (*Panicum virgatum*), downy brome (*Bromus tectorum*), seaside goldenrod (*Solidago sempervirens*), rugosa rose (*Rosa rugosa*), and winged sumac. Phragmites was also present in places, but was not dominant. As they are adjoining types, the high point open sand/scrub species grade into the upland scrub species in areas 4 and areas 5.

4.17.3 Water Quality

Surface water quality was not measured at site ISS01 because the three small ponds on the site are very small and isolated. They were not viewed as key elements in the potential restoration options for the site.

4.17.4 Wildlife

Wildlife and their signs (tracks, scats, calls, and other identifiable physical evidence) observed at the site while conducting the field studies included red fox (*Vulpes vulpes*), yellow warbler (*Dendroica petechia*), common yellowthroat (*Geothlypis*

trichas), white-eyed vireo (*Vireo griseus*), and diamondback terrapin (*Malaclemys terrapin terrapin*).

Several apparently current red fox dens were noted on the northwestern-most high point (areas 6). One individual was observed in the larger of the two open areas in the central part of the site. No foxes were observed in the vicinity of the dens in the southeastern open area, but many dismembered remains of ducks and other waterfowl were present, indicating recent use. It is not known whether the foxes (assuming there is more than one individual) are permanent or transient residents on the island. It was interesting to note that red foxes were found in similar situations (i.e., high points of island, open sandy areas, etc.) at all of the island sites studied. Because of the density of the vegetation on all other parts of Cedar Bonnet Island, it is not likely that the foxes use other areas of the site for denning.

One adult female diamondback terrapin was observed apparently immediately after laying eggs (she was approximately 10-inches long) during the field studies in late June 2000 in the southeastern open sandy area. This open area possessed many old terrapin scrapes and eggshells, apparently from last year. Some places in this open area possessed scrapes and old shells every few feet. Several fox dens were present in this area. It is not known whether foxes currently use these dens, but detritus, including miscellaneous gull body parts and feathers, were present. From the observation of the single terrapin on the area, however, it is likely that it has been visited by other terrapins this year as well. It is somewhat remarkable that terrapins were able to find this site (the same is true for the resident foxes), as it is about 200 feet from the water at the closest point, through dense phragmites and scrub. It is not currently known if or to what degree the foxes (or other predators such as domestic dogs or raccoons) impact the terrapins that use the site. Some very old terrapin scrapes were also observed in the larger, central open sandy area, but no evidence of current egg-laying was found. Fox dens were also present, and an adult fox was observed in this location.

Most of the birds observed at the site were seen or heard in the upland scrub habitat adjacent to the several existing footpaths through the island. Because the field visits were all relatively early in the year, some birds that nest at the island may have been missed. The ISS01 site is also a likely stop-over place for migrating birds in the spring and fall of the year. It should be noted, however, that despite the presence of moderately-sized areas of upland shrubs and trees, no signs of long-legged wading birds (i.e., colonial nesting species such as egrets and herons) were observed on Cedar Bonnet Island. This could be owing to the presence of the foxes and other predators, human disturbance (the site is very close to Long Beach Island and is connected to the causeway), or other factors. No wildlife were observed in the three isolated ponds in the northeastern part of the site. These ponds did not appear to be particularly valuable to wildlife because of their shallowness, their apparent relatively poor water quality, apparent lack of SAV, and the fact that they were completely surrounded by very dense phragmites.

4.17.5 Environmental Problems at the Site

Loss of Habitat from Dredging and Filling

It is almost certain that dredged materials were originally placed directly on tidal marsh to create the disposal site. Assuming the deposition was originally on tidal marsh, this would equate to a historic loss of about 78 acres of tidal marsh (65 acres of existing tidal marsh subtracted from the 143 total acres of the site). The existing phragmites habitats on the site as a result of fill activities are generally lacking in quality for several groups of wildlife, including long-legged nesting birds and diamondback terrapins.

Dominance by Phragmites

Roughly 55 acres (slightly more than a third) of ISS01 contains communities dominated by dense stands of phragmites (areas 2, 3, and 4). Phragmites is firmly established in many of these areas (existing conditions are nearly perfect for its growth), and because of its density and tenacity it is very unlikely that this condition will change without intervention. These large, monotypic areas of phragmites provide little value as habitat to most groups of wildlife.

4.17.6 Restoration Constraints and Other Site Information

The New Jersey Natural Heritage database indicates that records exist for piping plover (*Charadrius melodus*), northern harrier (*Circus cyaneus*), black skimmer (*Rynchops niger*), least tern (*Sterna antillarum*), roseate tern (*Sterna dougallii*), and common tern (*Sterna hirundo*) in the vicinity of the ISS01 site. From the Heritage location records of these six species, all were apparently observed in and around the tidal marshes in the western, eastern, and southern parts of the site (not in the phragmites and scrub habitats in the central part of the site). The dates when these species were recorded varies from 1982 (black skimmer) to 1992 (least tern). Piping plovers are listed as federal Threatened and state Endangered. They are considered to be somewhat rare throughout their natural range, and their breeding populations are considered critically imperiled in New Jersey. Breeding populations of northern harrier are state listed as Endangered; the status of non-breeding populations has not been determined by the state. Both breeding and non-breeding populations of black skimmers are state listed as Endangered, but are apparently secure throughout their natural range. Least terns are state listed as Endangered; they are apparently secure throughout their natural range, but breeding populations are considered critically imperiled in New Jersey. Roseate terns are federal and state listed as Endangered; they are apparently secure within their natural range, although some subspecies are very rare. Breeding populations of common terns are listed as declining in the state, and non-breeding populations are apparently secure within the state; they are apparently secure throughout their natural range. None of these six species were observed on Cedar Bonnet Island during the Barnegat field studies. Because all of existing areas of tidal marsh would be preserved under the proposed restoration plan, no negative effects to the listed species are anticipated. It is likely that

these species would benefit from the creation of approximately 2 acres of tidal wetlands proposed in this restoration plan (see project concept details, below).

The ISS01 site is part of an area designated by NJDEP Heritage as the Manahawkin Bay Macrosite, a Natural Heritage Priority Site. According to Heritage, the macrosite contains a large stretch of back bay and salt marsh islands, providing habitat to many rare colonial waterbirds (many are state listed species). The site is also part of the Cedar Bonnet Island Macrosite, a Natural Heritage Priority Site. This macrosite includes only the southern portion of Cedar Bonnet Island. According to Heritage, the site contains nesting habitat for a globally rare state Endangered bird, and other habitats for four other state Endangered birds.

The ISS01 site contains large areas of relatively pristine tidal marsh that must be protected from direct and indirect effects resulting from restoration efforts. Submerged aquatic vegetation exists in one small parcel (wigeon grass) off the southeastern corner of the site; this must also be protected during restoration at the site. It is estimated that with proper planning and use of appropriate best management practices and sediment erosion and control techniques, however, such effects could be eliminated.

Because of its location near Ship Bottom on Long Beach Island, the site is within 500 feet of some residences and public facilities. Restoration efforts at the site must take this public presence into account during the design and implementation phases. Both public safety factors (e.g., spraying herbicides for phragmites control) and aesthetics (e.g., material-moving/re-location) must be taken into account in any restoration at the site. "Aquatic Pesticide Permits," issued by NJDEP, Pesticide Control Program would be required for all the large-scale herbicide applications in the Barnegat projects. The spray permits are typically issued under a pesticide license maintained by the pilot or airport supplying the aircraft (personal communication, Eric Schrading, USFWS). In addition, the prescribed burning recommended at this site would also likely require a permit from the New Jersey Forest Fire Service.

4.17.7 Restoration Concept

The restoration concept at ISS01 includes creation of additional, upland open sandy habitat and creation of two new small areas of tidal wetlands. The project would increase ecological diversity; provide new habitats for diamondback terrapins, a species of concern in the region; and increase tidal wetlands at the site. These habitats would be created from two existing upland phragmites-dominated areas (areas 3) by pushing or moving existing dredged materials from these areas to parcels adjacent to the southeastern open area. Approximately 3 acres of new open sandy habitat in two parcels would be created adjacent to the existing southeastern area. One of these parcels (about 2 acres) would be directly to the west of the existing southeastern open area, in a phragmites-dominated community (existing shrubs and trees bordering the southeastern area would be preserved). The other new parcel (about 1 acre) would be created immediately to the east of the southeastern open area in another phragmites-dominated community. In addition, approximately 2 acres of new tidal wetlands would be created as

a result of moving the material out of the existing upland phragmites areas. Both parcels of new wetlands would have a hydrologic connection (via canal) to the adjacent tidal waters. It is anticipated that the created tidal wetlands would be colonized by cordgrasses, salt hay, salt-tolerant rushes, high tide bush, and other salt-tolerant vegetation.

The small areas of new tidal wetlands would improve the existing habitat values at the site and would have the additional benefit of improving access to the open sandy areas for diamondback terrapins. The terrapins currently must traverse several hundred feet (at the closest point) through dense phragmites and upland scrub to reach the existing southeastern open sandy area.

It is assumed that once the material is removed from the two phragmites parcels (areas 3), excavated to the vertical height of the adjacent tidal wetlands, and provided a tidal connection, they will revert to tidal marsh. Providing all of the fill is material removed from areas 3, a total of about 2 acres of tidal wetlands would be created.

The existing phragmites in areas 3 would be eradicated prior to movement of the fill; it would also be eradicated in the parcel to the west of area 3 where fill would be deposited. Eradication would probably best be accomplished by aerial spraying of an herbicide agent containing glyphosate that is EPA-registered for use in aquatic and semi-aquatic environments.

4.17.8 Project Implementation

About 2 acres of new tidal wetlands would be created. Excavation would take place in both parcels of area 3. Both of these parcels are currently approximately 7 feet above mean high water. The existing undisturbed tidal marsh adjacent to the site is approximately 1 foot (and less) above mean high water. To calculate this volume of fill, 2 acres = 87,120 ft^2 X 6 vertical feet = 522,720 cubic feet = 19,360 cubic yards of material would be generated. The materials could be excavated and moved on the site using a small bulldozer, backhoe, or similar piece of equipment. Equipment would likely have to be brought in by barge or similar craft to the southeastern end of the site. With proper planning it will be possible to gain access to both of the area 3 parcels without moving through wetlands. The wetlands would be excavated from north to south. For the southeastern new wetland, a canal would be dug from its southern end through the existing uplands in area 4 and into the tidal waters. The canal would be approximately 150 feet long and 20 feet wide by 7 feet deep; this equates 21,000 cubic feet = 778 cubic yards of materials. For the southwestern new wetland, a canal would be dug from its southeastern end to the east through a very narrow area of wetland phragmites (area 2) and a narrow area of upland phragmites (area 4) and into the tidal waters. The canal would be approximately 100 feet long and 20 feet wide by 7 feet deep; this equates 14,000 cubic feet = 518 cubic yards of materials. It is assumed that the marsh restoration would encourage re-growth of a suite of vegetation similar to that in adjacent "unaffected marsh." Success at similar tidal restoration sites was recently described in Zedler (2000), where vegetation successfully colonized with little or no planting from adjacent wetlands

and the tide. The canal cutting could be performed by a dragline from the water (SAV habitats, however, must be avoided). Owing to the fact that all of the access to create these sites would likely be from uplands or the water, no protective devices such as bog mats would be necessary. All materials excavated from the tidal wetlands creation would be used to create the two new open sandy areas (see below).

Areas 4, where the two new open sandy parcels would be created, are currently an average of about 8 feet above mean high water. The two open sandy high points are currently at about 12 feet above mean high water. To raise 3 acres of new parcels from 8 vertical feet to 12 vertical feet (to match the elevation of the high points) would be calculated as 3 acres =130,680 ft^2 X 4 vertical feet = 522,720 cubic feet = 19,360 cubic yards. This would be approximately equivalent to the quantity of the material generated from the tidal wetlands creation. The materials excavated from the tidal wetlands creation would then be applied to the new open sandy parcel sites.

Phragmites eradication in the approximately 5-acre work area would take place at the end of the growing season prior to the material excavation. For the best effect of the glyphosate herbicide, spraying of the phragmites would take place from early to mid-September. This is because the best effect of the herbicide is achieved when transport of the photosynthesized sugars from the leaves of the plants to its rhizomes is maximized, reportedly during this time of year (Harriott and Burton 1997). Because of the open nature of the site, spraying could be accomplished either by fixed-wing craft or by helicopter (costs may be significantly lower by fixed-wing craft). For best success of removal, all phragmites eradication would be performed at one time (or on successive days). Proper care must be taken to closely follow all manufacturer application and safety guidelines, particularly regarding appropriate wind and climatological conditions. The dead phragmites stands would then be control-burned in the winter to remove dead standing canes (winter burning maximizes the number of dead phragmites canes), and to enhance the success of follow-up herbicide treatments. It is recommended that follow-up aerial herbicide and burning treatments be made with the same timing (i.e., early fall herbicide treatment and winter burning) over at least three successive years after the excavation work. In addition, site inspections must be made beginning in late spring after the first aerial application to monitor the success of the phragmites eradication. Persistent problem areas after several treatments must be noted; these (smaller) areas would be hand-sprayed with backpack sprayers or similar devices.

Monitoring and maintenance of the site will involve a semi-annual inspection over at least three consecutive years to monitor the created habitats for success of the tidal wetlands and open sandy habitats. Notations will be made on use of the sites by diamondback terrapins. It may also become necessary to temporarily implement a predator control program on the sites and adjacent areas to ensure success of terrapins at the site. The predator control program would be directed at red fox populations, as well as domestic animals; the program would likely involve trapping and re-location of foxes and domestic animals. Phragmites invasions onto any of the created areas would be mapped during the semi-annual inspections, for use in either successive aerial or hand applications of herbicide.

4.17.9 Potential Environmental Impacts

Environmental impacts resulting from the proposed project would include loss of about 3 acres of upland phragmites-dominated habitats. This habitat is colonized by relatively monotypic stands of phragmites and is not likely of significant habitat value. A very small quantity of wetland phragmites habitat (area 2) would be converted to open water from cutting the channel from the created southwestern wetland. Assuming about 50 feet of the 100-foot channel was within the wetland phragmites, this would equate to 50 feet X 20 feet = 1,000 square feet = 0.02 acre of disturbance. Considering that the phragmites wetlands would only be converted to open water habitat, and that about 3 acres of new tidal wetlands would be created by the project, the conversion is considered beneficial.

Providing appropriate best management practices and soil erosion and sediment control techniques are employed in implementing the work, potential environmental impacts would be minimized.

Implementation of the project would not likely result in any additional significant positive or negative impacts relating to air quality and noise levels, water quality, wetlands and other special aquatic areas, finfish, including Essential Fish Habitat, wildlife resources including, but not limited to, the target species that have been identified, and threatened and endangered species.

4.17.10 Estimated Costs

The following approximate estimated costs relate to the principal elements of the project implementation at site ISS01, as stated above, assuming the project is not conducted in conjunction with other restoration projects. The costs listed are approximate only, subject to change, and are primarily intended to provide perspective of the relative magnitude of the project. It must also be noted that where a range of costs for each item was available, the maximum cost was used.

Sandy material moving/spreading:
20,656 cubic yards @ $35.00 per c.y. = $722,960

Phragmites eradication:
Aerial herbicide: 5 acres @ $79.00 per acre = $395.00 X 3 treatments = $1,185.00
Controlled burn: $800.00 X 1 visit = $800.00

Monitoring and maintenance:
Phragmites mapping/bird monitoring/backpack spraying: $800.00 X 6 visits = $4,800.00

GRAND TOTAL = $729,745

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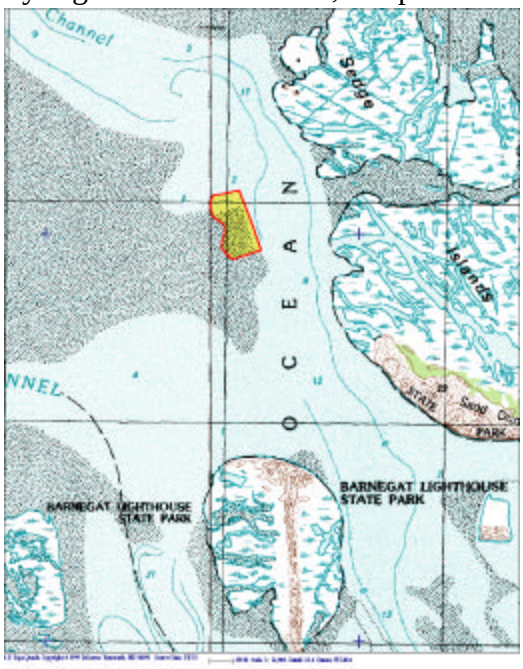
4.18 SITE ISS08 (ISLAND 26A)

4.18.1 Site Description and Ownership

Site ISS08 (Island 26A) is owned by the New Jersey Department of Environmental Protection (NJDEP). It is located in Barnegat Bay, approximately 1.5 miles northwest of Barnegat Lighthouse on Long Beach Island. The site is roughly egg-shaped, longest from north to south, and is a total of approximately 22 acres. The site was last used for dredged materials disposal about 4 years ago. According to NJDEP, phragmites was treated with herbicides several years ago, resulting in the current explosion of beachgrass growth on the island (personal communication, David Jenkins, NJDEP). Beach-nesting birds such as skimmers and terns, who once nested here no longer nest on the island because of the dense vegetation. Herring gulls and greater black-backed gulls, who will nest in vegetation, have dominated the island as a result, and appear firmly established here. Island 26A is currently highest near its center, but possesses a locally-rolling topography. Two main open sand areas currently exist (areas 2, Figure 4-18) in an area on the northwest side and another area near its center. The remainder of the site possesses an upland dune community that is dominated by beachgrass (see Vegetation and Land Cover, below).



Because the most recent field studies for this site coincided with the active nesting season (at least 500 gulls were nesting on the island), the field observations were taken from the boat; no attempt was made to land at the island. From these observations and from notes taken during previous visits to the island, the two highest points on the island are about 12 to 15 feet above mean high tide; the average elevation throughout is 6 to 8 feet above mean high water. The substrate is coarse to medium sand throughout (refer to data sheet, Appendix B).

ISS08A. View looking northeast from the northeastern part of ISS08. Note the presence of some relatively dense dune vegetation that is colonizing the island.

ISS08B. View from the water looking at the eastern side of ISS08. It should be noted that the island was not accessed by foot during the spring and summer Barnegat Environmental field studies because of the large number of nesting gulls, oystercatchers, and other birds that were present. Other visits were made to the island during fall and winter months.

4.18.2 Vegetation and Land Cover

The primary vegetation type at site ISS08 (Island 26A) consists of an upland dune community (area 1, Figure 4-18). The dune community is all herbaceous; most of the species present are relatively short. Beach grass (*Ammophila breviligulata*) is the principal species, but seaside goldenrod (*Solidago sempervirens*), white sweet clover (*Melilotus alba*), downy brome grass (*Bromus tectorum*), and phragmites (*Phragmites australis*) are also present and locally abundant. The remaining land cover on the site is open (unvegetated), wind-blown sand (area 1, Figure 4-18).

Submerged aquatic vegetation (SAV) was mapped in one very large parcel on the northwestern side of the island (Figure 4-18). The bed was composed entirely of eelgrass (*Zostera marina*), and appeared dense to very dense and healthy. The SAV extended outside the study area (and off of the aerial photograph used for the field mapping); its full extent to the west was not mapped. It was noted that water visibility was greater than 10 feet during the field studies, and was considered excellent (compared with visibilities of 1 foot at other sites in the study area). No other areas of SAV were located in the vicinity of Island 26A.

4.18.3 Water Quality

Surface water quality was not measured at site ISS08 because no surface water features exist on the island. From previous studies in the area, however, it is known that the salinity of the area waters are on the order of about 30 parts per thousand (similar to ocean water) (Harriott and Burton 1996).

4.18.4 Wildlife

Wildlife observed at the site were all birds, many of them breeding adults with recently-fledged young. It was estimated that about 500 total birds were using the island at the time of the field studies. By far, the most numerous birds were herring gulls (*Larus argentatus*) and greater black-backed gulls (*Larus marinus*). Also present on the island were laughing gull (*Larus atricilla*), American oystercatcher (*Haematopus palliatus*), double-crested cormorant (*Phalacrocorax auritus*), and song sparrow (*Melospiza melodia*). Other species observed in the water or flying over the island included common loon (*Gavia immer*), mallard duck (*Anas platyrhynchos*), common tern (*Sterna hirundo*), and Forster's tern (*Sterna fosteri*). It was interesting to note that many of the common terns observed were carrying small fish, but were only flying over the site (no terns were tolerated on the site by the gulls).

It is also reported that a red fox was planted on the island several years ago in an unsuccessful attempt to rid the island of its large gull population (personal communication, David Jenkins, NJDEP). No evidence of red foxes was noted during the field studies.

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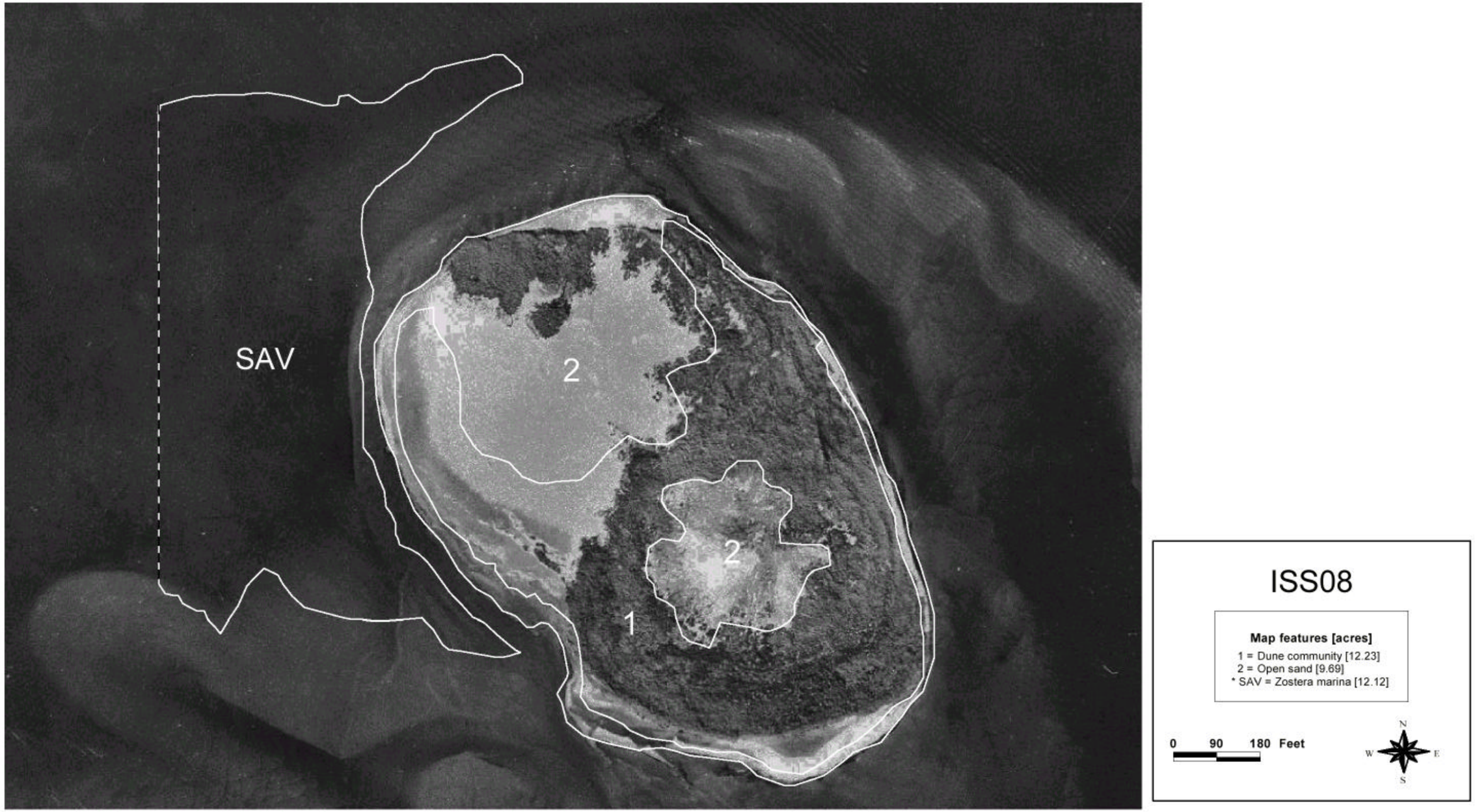

Figure 4-18. Vegetation and land cover of site ISS08. Features were drawn in the field directly onto recent low-altitude, black and white, digitally rectified aerial photographs (USACE 1998). Wetlands vegetation and land cover types are indicated by an asterisk (*) in the legend.

4.18.5 Environmental Problems at the Site

Loss of Habitat from Dredging and Filling

Dredged materials were originally placed directly in shallow open water to create Island 26A. This would equate to a historic loss of about 22 acres of shallow open water habitats. It is not known whether any SAV beds or other wetlands were affected by dredged material disposal.

4.18.6 Restoration Constraints and Other Site Information

The New Jersey Natural Heritage database indicates that records exist for osprey (*Pandion haliatus*) in the vicinity of the ISS08 site. It is not clear from the location description provided by Heritage, however, where exactly the 1987 record was from in relation to the island. There is currently no woody vegetation on the island for ospreys to land on, so it seems unlikely that they would use it regularly. Ospreys are listed in New Jersey as Threatened and their breeding populations are considered imperiled in the state. They are globally secure, however, throughout their natural habitat. Ospreys were occasionally observed flying in the general area of the island; no nests were observed during any parts of the entire Barnegat study area. Based on the general nature of the proposed restoration and the size of the ISS08 site relative to adjacent habitats on the Bay, it is unlikely that ospreys would be either positively or negatively affected by the proposed restoration project.

The ISS08 site is part of an area designated by NJDEP Heritage as the Island Beach Macrosite, a Natural Heritage Priority Site. According to Heritage, the macrosite contains large expansive beaches, dunes, and wetlands on and adjacent to Island Beach State Park. The marsh and dune systems provide habitats for rare plants, birds and natural communities. The site is also part of the Sedge Islands at Island Beach Macrosite, another Natural Heritage Priority site. According to Heritage, the macrosite possesses tidal salt marsh and marsh islands that provide habitats for many bird species. The area contains osprey nest structures on platforms and poles.

The biggest constraint to restoration of this site is the current, apparently fully established gull population. Considering the fact that the gulls have bred successfully at the island for several years and have apparently succeeded in excluding both terns and skimmers from the island, it will certainly take aggressive measures to get them to leave, even after the physical restoration measures are complete.

"Aquatic Pesticide Permits," issued by NJDEP, Pesticide Control Program would be required for all the large-scale herbicide applications in the Barnegat projects. The spray permits are typically issued under a pesticide license maintained by the pilot or airport supplying the aircraft (personal communication, Eric Schrading, USFWS).

Submerged aquatic vegetation was observed in one large parcel off the northwestern end of the island. This large SAV bed must be avoided and strictly

protected during any restoration efforts at Island 26A. In addition, there are many very shallow areas around the island owing to shoaling; these shallow areas make boat access to the site somewhat difficult. The easiest boat access to the island is currently from the northeast.

4.18.7 Restoration Concept

The restoration concept at ISS08 incorporates several related elements, including (1) eliminate the existing vegetation (2) flatten the rolling hills (3) stabilize the sand to the greatest degree possible to protect SAV and aquatic resources from erosion of sand off the island (4) add a layer of crushed shell to discourage re-growth of vegetation, and (5) take active measures to discourage the existing gull population and encourage the beach-nesting bird population (e.g., terns, black skimmers, American oystercatcher, etc.). The project would provide almost ideal habitat for beach-nesting species, in that it would be an open, sandy, flat site where these birds could breed with minimal pressures from mammalian (e.g., foxes) and avian predators (e.g., gulls).

It must be noted that the restoration could be implemented regardless of future dredged materials disposal operations at the island. The restoration could be completed without addition of any new sandy materials. As it is considered an important, active disposal site, however, the project implementation will be planned with these activities in mind.

The existing approximately 12 acres of dune vegetation on the island (area 1) would be eradicated prior to deposition of new materials. Eradication would probably best be accomplished by aerial spraying of an herbicide agent containing glyphosate that is EPA-registered for use in aquatic and semi-aquatic environments.

4.18.8 Project Implementation

Vegetation eradication would take place in the 12-acre dune community at the end of the growing season, and prior to the material deposition. For the best effect of the glyphosate herbicide, spraying of the phragmites would take place from early to mid-September. This is because the best effect of the herbicide is achieved when transport of the photosynthesized sugars from the leaves of the plants to its rhizomes is maximized, reportedly during this time of year. Because of the open nature of the site, spraying could be accomplished either by fixed-wing craft or by helicopter (costs may be significantly lower by fixed-wing craft). For best success of removal, all vegetation eradication would be performed at one time (or on successive days). Proper care must be taken to closely follow all manufacturer application and safety guidelines, particularly regarding appropriate wind and climatological conditions.

After the dune vegetation has been successfully eradicated, new sandy dredged materials could be added to the site (based on the most recent disposal action at the site, it could be assumed that 3 feet of material would be added). This quantity of material would be 20 acres = 871,200 ft^2 = 2,613,600 cubic feet = 96,800 cubic yards. When deposition is complete, the material would be flattened to the greatest degree possible

with a small piece of earth-moving equipment such as a backhoe or a bobcat (the object is to flatten the entire site as much as possible). It should be noted that the restoration could potentially be successful without the addition of new materials (i.e., just flatten existing materials). To avoid the worst of the shoals surrounding the island and the large parcel of SAV to the west of the island, the equipment would be brought in by barge or similar craft to the site at its northeastern end. Immediately after the materials have been flattened, jute erosion mats would be installed over the entire area. After installation of the mats is complete, a layer of crushed shells would be added over the entire site to inhibit vegetation re-growth. The shells will not affect nesting success (personal communication, David Jenkins, NJDEP).

After the physical work is completed, an active "gull discouragement" program would be employed at the site. Because species such as the herring gull and greater black-backed gull begin nesting earlier than the desired species (i.e., terns and black skimmers), the program must be initiated in late December or early January (well before the gulls begin nesting). Elements in the program would consist of active harassment rather than trapping or killing. Such elements could include a combination of pyrotechnical devices, harassment by sheep dogs, release of foxes on the island, frequent human presence with direct harassment (i.e., graduate student temporarily camped on island), nest destruction and egg addling, and other techniques. It should be noted that success of such a program would likely be proportionate to the level of effort in its implementation. It is apparent that such a program would have to be implemented aggressively for several years to ensure success. Because a number of these techniques may have to be employed for success, a general fund would be established for their implementation.

All gull harassment activities must be terminated for the year before terns and black skimmers have returned to the area for breeding (most likely by the end of March in the area of the project). Immediately after the harassment activities have ceased, decoys of the target species will be set out at the site to attract terns, black skimmers, and other desirable species.

Monitoring and maintenance of the Island 26A will involve a semi-annual inspection over at least three consecutive years to monitor for tern and black skimmer re-establishment and the gull population. Ongoing gull harassment techniques shall be used at the site until their numbers are significantly reduced and the desired species have established breeding populations at the island.

4.18.9 Potential Environmental Impacts

Environmental impacts resulting from the proposed project would primarily be limited to migration of dredged materials off the island after deposition. Such migration of materials could adversely affect the large parcel of SAV immediately to the west of the island by smothering. These effects could be greatly reduced or eliminated by use of the erosion mats and layers of crushed shells, as well as any other measures required in an approved erosion and sedimentation control plan.

The gull discouragement program would likely negatively impact the resident herring gull and greater black-backed gull population at Island 26A. Local populations of these species, however, have recently dramatically increased, often at the expense of less common species like terns and black skimmers. It is unlikely that the negative impact on the resident gulls as a result of the project at Island 26A would negatively affect the overall gull population in the Barnegat Bay study area.

Implementation of the project would not likely result in any additional significant positive or negative impacts relating to air quality and noise levels, water quality, wetlands and other special aquatic areas, finfish, including Essential Fish Habitat, wildlife resources including, but not limited to, the target species that have been identified, and threatened and endangered species.

4.18.10 Estimated Costs

The following approximate estimated costs relate to the principal elements of the project implementation at site ISS08, as stated above, assuming the project is not conducted in conjunction with other restoration projects. The costs listed are approximate only, subject to change, and are primarily intended to provide perspective of the relative magnitude of the project. It must also be noted that where a range of costs for each item was available, the maximum cost was used. The cost for excavation and placement of the sandy dredged materials was taken from a recent USACE Early Action Report prepared for another environmental restoration project on Barnegat Bay (USACE 2000). This cost provides for costs of excavation and placement only, and does not include mobilization, demobilization, and preparatory work, or other costs. The rationale for this is that the project would be most economically feasible if it were completed concurrent with dredging of Barnegat Inlet or another local waterway.

Sandy material moving/spreading:
96,800 cubic yards @ $7.00 per c.y. = $677,600

Phragmites eradication:
Aerial herbicide: 12 acres @ $79.00 per acre = $948.00

Materials:
Erosion mats = $10,000
Crushed shell = 9,680 c.y. (20 acres, 3 inches thick) @ $5.00 per c.y. = $48,400

Monitoring and maintenance:
Bird monitoring/gull harassment: $10,000

GRAND TOTAL = $746,948

4.19 SITE ISS02 (FLAT ISLAND)

4.19.1 Site Description and Ownership

Site ISS02 (Flat Island) is privately owned by the Flat Islands Investors Corporation. It is located in Barnegat Bay, approximately 1 mile southwest of Ship Bottom, Long Beach Island. The site is key-shaped, longest from northeast to southwest, and is a total of approximately 69 acres. The site has been used for the disposal of dredged material within the past 20 years; it possesses a substantial berm around its entire circumference, and another unrelated long one through its center (perhaps this served as a baffle dike). ISS02 is highest in elevation in two places, one on the northwestern end and one on the southwestern end (areas 6, Figure 4-19), where open areas of sand, grasses, and scrub are present. Adjoining these high spots are two large parcels and one separate parcel (areas 3) that are close to the vertical elevation of the high spots (all three of these contain upland deciduous scrub; see Vegetation and Land Cover, below).

Substrate corings taken throughout the site and other measurements indicate that the fill in the highest parts of the site (areas 6) is an average of about 11 feet above the undisturbed marsh encircling the site (these high areas are filled above the top of the perimeter berm); the substrate in this area consists of medium sand. The adjacent areas 3 are about 8 feet above the site undisturbed marsh (these areas are filled to the top of the berm); all three areas 3 consist of medium sand. The remainder of the site (with the exception of the tidal marsh and open water) is an average of about 2 feet above the site undisturbed marsh. Groundwater was intercepted at or near the surface in the substrate corings throughout area 1; the substrate throughout this low area is fine silt (refer to data sheet, Appendix B).

ISS02A. View looking northwest through a small, isolated pond in the northeastern corner of ISS02. The pond was only several inches deep during the summer 2000 field studies; phragmites appears to be colonizing the pond. Note the density of the phragmites encircling the pond.

ISS02B. View looking north at the relatively large area of undisturbed tidal marsh along the southwestern edge of the ISS02. This habitat is dominated by *Spartina patens* and *Spartina alterniflora*. Several birds of note were observed here during the summer 2000 Barnegat field studies, including seaside sparrow, salt marsh sharp-tailed sparrow, and willet. It is possible that all three of these species breed here.

ISS02C. View looking northwest through part of the open, sandy area at ISS02. Several red fox dens were observed in this area, but they did not appear to be currently used. No evidence was present of recent use by diamondback terrapins. The principal vegetation in this area was American beachgrass, switchgrass, bayberry, and rugosa rose.

4.19.2 Vegetation and Land Cover

The primary vegetation type at site ISS02 (Flat Island) is phragmites marsh (area 1, Figure 4-19). The phragmites marsh is generally monotypic (*Phragmites australis*) throughout, and comprises more than half the vegetation and land cover at the site. The only other species noted frequently was high tide bush (*Iva frutescens*), observed primarily along the outer edges of the phragmites marsh. The next largest vegetation type at Flat Island is upland deciduous scrub (areas 3). The principal species in the upland scrub are bayberry (*Myrica pensylvanica*), smooth sumac (*Rhus glabra*), winged sumac (*Rhus aromatica*), sassafras (*Sassafras albidum*), poison ivy (*Toxicodendron radicans*), and Virginia creeper (*Parthenocissus quinquefolia*). The third largest vegetation type at the site is tidal marsh (area 5). Salt marsh cordgrass (*Spartina alterniflora*) and salt hay (*Spartina patens*) are the principal species in the tidal marsh; salt marsh spike grass (*Distichlis spicata*), perennial glasswort (*Sarcocornia perennis*), and common pigmyweed (*Crassula aquatica*) are also locally abundant. The largest area of tidal marsh is on the west side, just below the center of the site. This large, open area of marsh, interspersed with small areas of tidal pools appears to provide valuable habitats (see Wildlife, below). The high points on the site (areas 6) possess an open sand/deciduous scrub vegetation that is dominated by beachgrass (*Ammophila breviligulata*), switchgrass (*Panicum virgatum*), seaside goldenrod (*Solidago sempervirens*), rugosa rose (*Rosa rugosa*), and winged sumac. As they are adjoining types, the high point open sand/scrub species grade into the upland scrub species in areas 3. Several other smaller vegetation and land cover types were observed at Flat Island. A long,

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ISS02

Map features [acres]

* 1 = Phragmites-wet [36.88]
2 = Phragmites-dry [0.75]
3 = Upland scrub [18.69]
* 4 = Open water [0.66]
* 5 = Tidal marsh (Spartina spp.) [11.01]
6 = Open sand/Dune/Scrub [1.27]
* SAV = mixed (Zostera marina/Ruppia maritima) [9.91]

0 90 180 Feet

N W E S

Figure 4-19. Vegetation and land cover of site ISS02. Features were drawn in the field directly onto recent low-altitude, black and white, digitally rectified aerial photographs (USACE 1998). Wetlands vegetation and land cover types are indicated by an asterisk (*) in the legend.

narrow band of phragmites on uplands occurs on the interior baffle dike (area 2). Other vegetation on the baffle dike included an unidentified blackberry (*Rubus* sp.), pokeweed (*Phytolacca americana*), and poison ivy. Three small areas of largely unvegetated open water were mapped near the northeastern-most part of the site. These small ponds were all partly invaded by phragmites. One other area of open water, a tidal pool, was noted within the large area of tidal marsh in the western part of the site. This pool was largely unvegetated.

Submerged aquatic vegetation (SAV) was mapped in one large parcel on the southeastern side and another parcel on the southern side. Although the visibility through the water in this area was poor, it was determined that there was an approximately even mixture of both eelgrass (*Zostera marina*) and widgeon grass (*Ruppia maritima*). The SAV in both parcels appeared to be relatively healthy, and was dense to very dense. No other areas of SAV were located in the vicinity of Flat Island.

4.19.3 Water Quality

Surface water quality was not measured at site ISS02 because the three small ponds on the site (excluding the tidal pool on the western side) are very small and isolated. They were not viewed as key elements in the potential restoration options for the site.

4.19.4 Wildlife

Wildlife and their signs (tracks, scats, calls, and other identifiable physical evidence) observed at the site while conducting the field studies included red fox (*Vulpes vulpes*), fish crow (*Corvus ossifragus*), mallard duck (*Anas platyrhynchos*), willet (*Catoptrophorus semipalmatus*), sharp-tailed sparrow (*Ammospiza caudacuta*), seaside sparrow (*Ammospiza maritima*), yellow warbler (*Dendroica petechia*), indigo bunting (*Passerina cyanea*), and Fowler's toad.

Several apparently current red fox dens were noted on the northwestern-most high point (area 6). It is not known whether the foxes (assuming there is more than one individual) are permanent or transient residents on the island, or how they got there. It was interesting to note that red foxes were found in similar situations (i.e., high points of island, open sandy areas, etc.) at all of the island sites studied. No dens were present on the other open, sandy area in the southwestern part of the site. Because of the density of the vegetation on all other parts of Flat Island, it is not likely that the foxes use other areas of the site for denning. Several large, apparently current fish crow nests were observed within the southern-most area of upland deciduous scrub (area 3). Several adult crows were present in the vicinity of the nests during several visits to the site (other observers also indicated the presence of the crows near the nests on separate visits to the site). It is interesting to note, however, that despite the presence of these relatively large areas of shrubs and trees, no signs of long-legged wading bird (i.e., colonial nesting species such as egrets and herons) nesting were observed on Flat Island. This could be owing to the presence of the foxes and other predators, human disturbance (the site is relatively close to LBI), or other factors. Several male and female mallard ducks were observed in the largest of the three isolated ponds in the northeastern part of the site. These ponds did not appear to be particularly valuable to wildlife because of their shallowness, their apparently very poor water quality, lack of SAV, and the fact that they were completely "walled-in" (and in places

colonized) by very dense phragmites. A pair of willets were apparently nesting in the large area of marsh on the west side during the field studies, and were attempting to use distraction behavior to lead the investigators away from the nest (the nest was not located). Both sharp-tailed sparrows and seaside sparrows were frequently also observed singing in the large area of tidal marsh, and were assumed to be breeding in the vicinity. Several yellow warblers and one indigo bunting were also observed singing at the upland edges of the large marsh. Interestingly, one Fowler's toad was also found on the wet substrate of the large area of marsh.

4.19.5 Environmental Problems at the Site

Loss of Habitat from Dredging and Filling

It is not currently certain whether dredged materials were originally placed directly on tidal marsh, uplands, or open water (or a combination of these) to create the disposal island. It is most likely, though, that the fill was placed directly on tidal marsh. Assuming the deposition was originally on tidal marsh, this would equate to a historic loss of about 58 acres of tidal marsh (11 acres of existing tidal marsh subtracted from the 69 total acres of the site).

Dominance by Phragmites

More than half of ISS02 is dominated by a dense stand of phragmites marsh (area 1). Phragmites is firmly established in this parcel (existing conditions are nearly perfect for its growth), and because of its density and tenacity it is very unlikely that this condition will change without intervention (the parcel is in a "virtual climax" state). The high wildlife value of the large area of tidal marsh and the at least moderate value of the upland scrub areas are sharply contrasted with area 1, which is apparently of very little value to wildlife.

4.19.6 Restoration Constraints and Other Site Information

The New Jersey Natural Heritage database indicates that records exist for seven species of concern, including snowy egret (*Egretta thula*), black-crowned night heron (*Nycticorax nycticorax*), little blue heron (*Florida caerulea*), Louisiana heron (*Hydranassa tricolor*), glossy ibis (*Plegadis falcinellus*), yellow-crowned night heron (*Nyctanassa violacea*), and northern harrier (*Circus cyaneus*) at Flat Island. The first five species (i.e., not including yellow-crowned night heron and northern harrier) were part of a minor coastal heron rookery that took place on the island in 1985. The Heritage record for yellow-crowned night heron was from nearly a decade earlier, in 1977. Northern harrier is not a colonial nesting species. Little information is available on the rookery of that year, or whether it also occurred in subsequent years there. Both breeding and non-breeding populations of snowy egrets are state listed as stable and not undergoing long-term increases or decreases. Breeding populations of black-crowned night heron are state listed as Threatened; non-breeding populations are stable. Both breeding and non-breeding populations of little blue herons are state listed as stable and not undergoing any long-term increases or decreases. Breeding populations of Louisiana heron are significantly increasing; non-breeding populations are decreasing. Breeding populations of glossy ibis are state listed as declining; non-breeding populations are stable. Both breeding and non-breeding populations of yellow-crowned night heron are state listed as Threatened. Breeding populations of northern harrier are state listed as Endangered; the status of non-breeding populations has not

been determined by the state. None of these seven species were observed on Flat Island during the Barnegat field studies. Because all of the existing areas of woody vegetation would be preserved under the proposed restoration plan, no negative effects to its potential use as a coastal rookery by the five listed species (and others) are anticipated. It is possible that the establishment of additional new wetland deciduous forested and scrub habitats could provide habitats for establishment of a small coastal rookery on the site.

The ISS02 site is also part of an area designated by NJDEP Heritage as the Manahawkin Bay Macrosite, a Natural Heritage Priority Site. According to Heritage, the macrosite contains a large stretch of back bay and salt marsh islands, providing habitat to many rare colonial waterbirds (many are state listed species).

As indicated above, the site is privately-owned, and potential future use of the island for dredged material disposal is not known. The site is apparently used on an as-needed basis by the owners as minor dredging projects are required (e.g., to improve navigation in lagoon community waterways) (personal communication, Bill Dixon, NJDEP). It may be possible to restore all or only parts of the island, depending on projected future needs by the owner.

"Aquatic Pesticide Permits," issued by NJDEP, Pesticide Control Program would be required for all the large-scale herbicide applications in the Barnegat projects. The spray permits are typically issued under a pesticide license maintained by the pilot or airport supplying the aircraft (personal communication, Eric Schrading, USFWS). In addition, the prescribed burning recommended at this site would also likely require a permit from the New Jersey Forest Fire Service.

Submerged aquatic vegetation was observed in one large and one small parcel in the southeastern and southern parts of the site totalling 9.91-acres. Both parcels were noted to contain both eelgrass (*Zostera marina*) and wigeon grass (*Ruppia maritima*); the beds appeared dense and were apparently healthy. This large SAV bed must be avoided and strictly protected during any restoration efforts at Flat Island.

4.19.7 Restoration Concept

The restoration concept at ISS02 is twofold (1) re-establish an approximately 8-acre area of tidal marsh in the western part of the site adjacent to the large existing area of tidal marsh, and (2) raise the elevation in several areas of the existing phragmites marsh to allow for establishment of new wetland deciduous forested and scrub habitats (these would connect to the existing upland scrub habitats).

The concept would be to move existing dredged materials immediately to the east of the large tidal marsh to expand the existing marsh. With the tidal connection complete in the newly-excavated area, no marsh vegetation would need to be planted because of active seed recruitment and vegetative colonization. It is anticipated that the tidal connection would allow for establishment of cordgrasses, salt hay, salt-tolerant rushes, high tide bush, and salt-tolerant vegetation. Phragmites would be kept out of the excavated area by the saline tide. It is assumed that the marsh restoration would encourage re-growth of a suite of vegetation similar to that in

adjacent "unaffected marsh." Success at similar tidal restoration sites was recently described in Zedler (2000), where vegetation successfully colonized with little or no planting, from adjacent wetlands and the tide.

The materials moved from the marsh creation area would be placed between the two areas of upland scrub (areas 3) in the northern part of the site and on the north side of the upland scrub area in the southern part of the site to create a total of 8 acres of new habitat. The new wetland habitats would then be planted with native trees, shrubs, and herbaceous plants. Because the area 3 upland habitats are surrounded by area 1 wetlands (phragmites marsh), the intention of this action would be to provide only enough elevation with the fill placement for successful establishment of wetlands trees and shrubs (not to establish upland habitats similar to those currently existing in areas 3); no net loss of wetlands would occur. Current physical conditions in most areas of the phragmites marsh are too wet for establishment of a diversity of forested species. It is estimated that this part of area 1 could accept 2 vertical feet of material and still retain its wetlands characteristics. Examples of target species in the newly-created wetland shrub/scrub would include trees such as red maple, black gum, and persimmon, and shrubs such as high tide bush, and groundsel bush, and buttonbush.

Because of its mix of wide, open marsh, tidal pools, and intertidal mudflats, the existing large western area of tidal marsh is by far the most valuable wildlife habitat at the site. A number of species of birds were observed breeding in or otherwise using this habitat. Further, put into the context of historic tidal marsh wetlands loss at Flat Island (perhaps as much as 58 acres lost), re-establishment of this valuable resource seems appropriate. This is particularly true in light of the fact that materials excavated to re-establish the 8 acres of new marsh could in-turn be used to improve other site habitats.

The existing phragmites in the part of area 1 where the work is to take place (along with an additional "buffer" area) would be eradicated prior to movement of the fill. This would include the 8-acre excavation area plus an approximately 2-acre buffer, for a total of 10 acres of eradication. Eradication would probably best be accomplished by aerial spraying of an herbicide agent containing glyphosate that is EPA-registered for use in aquatic and semi-aquatic environments.

4.19.8 Project Implementation

The 8-acre part of area 1 that would be excavated for re-establishment of tidal marsh is currently about 2 vertical feet above the existing tidal marsh. To calculate this volume of fill, 8 acres = 348,480 ft^2 X 2 vertical feet = 696,960 cubic feet = 25,813 cubic yards of material would be generated. The materials could be excavated and moved on the site using a small bulldozer, backhoe, or similar piece of equipment. Equipment would likely have to be brought in by barge or similar craft to the site either through its northwestern end (preferred) or through its southern end. Access through the western end of area 3 in the northwestern part of the site would be preferable, as there are two existing landing areas on a high area where no tidal marsh is present (bog mats would not be required). If this access is used, excavation could be initiated from the eastern side of area 3, and could proceed from north to south. It may also be prudent to access the site from the southern-most area 3, and run the equipment along the edge of this area and

then northeast on top of the existing old baffle dike (area 2). One drawback to using this access is that crossing a narrow area of tidal marsh to get onto area 3 could not be avoided. The equipment could be brought in over bog mats or similar structures to help protect this narrow area of tidal marsh from excessive compaction. Access to the site by equipment would be limited to these two access points to minimize impacts to the existing tidal marsh.

Phragmites eradication in the 10-acre work area would take place at the end of the growing season prior to the material excavation. For the best effect of the glyphosate herbicide, spraying of the phragmites would take place from early to mid-September. This is because the best effect of the herbicide is achieved when transport of the photosynthesized sugars from the leaves of the plants to its rhizomes is maximized, reportedly during this time of year (Harriott and Burton 1997). Because of the open nature of the site, spraying could be accomplished either by fixed-wing craft or by helicopter (costs may be significantly lower by fixed-wing craft). For best success of removal, all phragmites eradication would be performed at one time (or on successive days). Proper care must be taken to closely follow all manufacturer application and safety guidelines, particularly regarding appropriate wind and climatological conditions. The dead phragmites stands would then be control-burned in the winter to remove dead standing canes (winter burning maximizes the number of dead phragmites canes), and to enhance the success of follow-up herbicide treatments. It is recommended that follow-up aerial herbicide and burning treatments be made with the same timing (i.e., early fall herbicide treatment and winter burning) over at least three successive years after the excavation work. In addition, site inspections must be made beginning in late spring after the first aerial application to monitor the success of the phragmites eradication. Persistent problem areas after several treatments must be noted; these (smaller) areas would be hand-sprayed with backpack sprayers or similar devices.

After phragmites eradication is determined to be successful on the new wetland areas, the 8-acre area can be planted with native trees, shrubs, and herbaceous plants. These would include a mixture of the native species noted in upland habitats at several area sites, including high tide bush (*Iva frutescens*), bayberry (*Myrica pensylvanica*), groundsel bush (*Baccharis halimifolia*), black gum (*Nyssa sylvatica*), persimmon (*Diospyros virginiana*), green ash (*Fraxinus pennsylvanica* var. *subintegerrima*), threesquare (*Scirpus pungens*), and bushy bluestem (*Andropogon glomeratus*). Assuming a minimal 250 plant-per-acre installation density, approximately 2,000 plants would be required for establishment of the 8-acre wetland area.

Monitoring and maintenance of the sites will involve a semi-annual inspection over at least three consecutive years to monitor the created habitats for success of the plantings and phragmites eradication. An approximately 85 percent minimal survival rate of the plantings the third year after installation will be applied as a measure of success. Phragmites invasions onto the upland restored area would be mapped during the semi-annual inspections, for use in either successive aerial or hand applications of herbicide.

4.19.9 Potential Environmental Impacts

Environmental impacts resulting from the proposed project would be primarily related to potential temporary loss of small areas of marsh vegetation and upland scrub during phragmites eradication. Herbicides containing glyphosate are non-selective, and will slowly kill virtually all

vegetation that they contact. Such losses will be minimized with the selection and use of the most appropriate spray equipment (e.g., spray nozzles, booms, etc.) and their use during optimal atmospheric conditions. Applied correctly in the appropriate concentrations, the herbicide is not anticipated to cause any negative effects to existing invertebrates, fish, and wildlife currently using the sites. Small areas of upland scrub would also be temporarily affected by deployment and movement of earth-moving equipment to access the work area. Appropriate use of erosion and sediment control measures (e.g., silt fences, temporary berms, biologs, etc.) would minimize sedimentation impacts to the adjacent tidal marsh and other sensitive areas during the construction work.

Implementation of the project would not likely result in any additional significant positive or negative impacts relating to air quality and noise levels, water quality, wetlands & other special aquatic areas, finfish, including Essential Fish Habitat, wildlife resources including, but not limited to, the target species that have been identified, and threatened & endangered species.

4.19.10 Estimated Costs

The following approximate estimated costs relate to the principal elements of the project implementation at site ISS02, as stated above, assuming the project is not conducted in conjunction with other restoration projects. The costs listed are approximate only, subject to change, and are primarily intended to provide perspective of the relative magnitude of the project. It must also be noted that where a range of costs for each item was available, the maximum cost was used.

Sandy material moving/spreading:
25,813 cubic yards @ $35.00 per c.y. = $903,455

Phragmites eradication:
Aerial herbicide: 10 acres @ $79.00 per acre = $790.00 X 3 treatments = $2,370.00
Controlled burn: $800.00 X 1 visit = $800.00

Plant materials/installation:
2,000 container seedling plants @ $3.00 each = $6,000.00
General labor 80 person-hours @ $35.00 per hour = $2,800.00

Monitoring and maintenance:
Phragmites mapping/bird monitoring/backpack spraying: $800.00 X 6 visits = $4,800.00

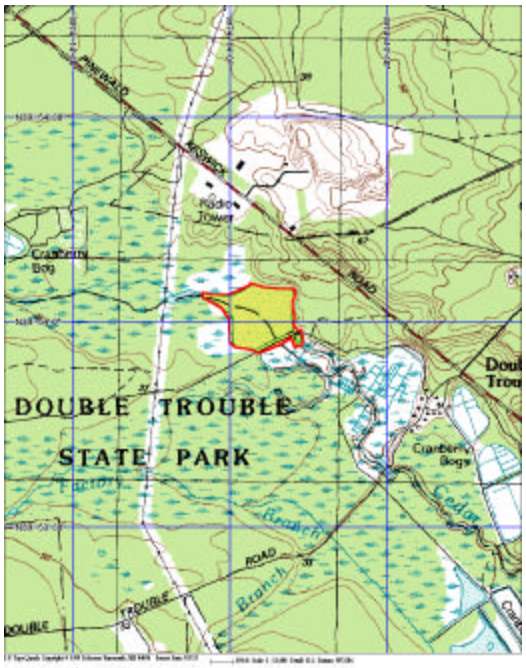
GRAND TOTAL = $920,225

4.20 SITE 33-17 (DOUBLE TROUBLE DAM)

4.20.1 Site Description and Ownership

Site 33-17, Double Trouble Dam, is owned by NJDEP, Division of Fish and Wildlife. It is located within Double Trouble State Park, off County Road 618, about 1 mile west of the Garden State Parkway. The site is a series of former cranberry bogs, homesteads, and forest, now managed for wildlife and recreation by NJDEP. The site of potential restoration interest at the state park is the Double Trouble Dam on Cedar Creek. The Double Trouble Dam currently presents a blockage to movement of fish and benthic organisms on Cedar Creek.

Measurements of the dam and spillway were made during the field studies (refer to data sheets for site 33-17, Appendix B). The site consists of a 1,100-foot concrete dam that is at 10 feet above mean sea level, with a concrete spillway on the southeast side. The top of the spillway is approximately 6 feet above the level of the downstream side of Cedar Run; the spillway is approximately 46 feet wide and 120 feet long. There is one main water control structure with a 48-inch concrete pipe and wooden trash rack, and one half-round metal standpipe that drains to another 48-inch concrete pipe. The dam connects two sides of an essentially north-south dirt access road. According to the most recent FEMA/USACE New Jersey dam inventory report, the normal storage of the Double Trouble pond is 333 acre-feet (FEMA/USACE 1999). The average surface area of the pond is 50 acres; the drainage area of Cedar Creek is 46 square miles. Further, Zich indicated the positive presence of alewife below the Double Trouble site (Zich 1977).



33-17A. View looking southwest from the Double Trouble dam, showing the main spillway and overflow structures.

33-17B. View looking southeast (downstream) immediately below the Double Trouble dam.

33-17C. View looking north at the concrete spillway and the impoundment at the Double Trouble dam. It appears technically possible that fish ladder structures could be added at this location.

4.20.2 Vegetation and Land Cover

Because of the nature of the proposed restoration at the Double Trouble site (i.e., retro-fitting of fish passage facilities at the existing dam), vegetation and land cover were not formally mapped at the site. Vegetation can be categorized in the vicinity of the dam as generally forested. Several large areas upstream and downstream of the dam are former cranberry bogs, now regenerated into wetland forest. To the immediate southwest and northwest and northeast on Cedar Creek and the Double Trouble pond is Atlantic white cedar forest that occasionally also grades to wetland deciduous forest. The forest is dominated by Atlantic white cedar (*Chamaecyparis thyoides*) and red maple (*Acer rubrum*) trees, with occasional thickets of speckled alder (*Alnus rugosa*), buttonbush (*Cephalanthus occidentalis*), highbush blueberry (*Vaccinium corymbosm*), and sweet pepperbush (*Clethra alnifolia*). The generally sparse herbaceous layer of the wetland forest is most often dominated by large cranberry (*Vaccinium macrocarpon*), royal fern (*Osmunda regalis*) and cinnamon fern (*Osmunda cinnamomea*). Father to the southwest, immediately beyond the Cedar Creek riparian corridor, is upland pine-oak forest. The dry forest is dominated by pitch pine (*Pinus rigida*) and several oak species, including scrub oak (*Quercus ilicifolia*), blackjack oak (*Quercus marilandica*), black oak (*Quercus velutina*), and white oak (*Quercus alba*). The forest possesses a dense shrub layer of lowbush blueberry (*Vaccinium angustifolium*) and huckleberry (*Gaylussacia baccata*). The herbaceous layer in the forest was very sparse to nonexistent; bracken (*Pteridium aquilinum*) is the only common herbaceous plant. Because of the presence of Cedar Creek and the Double Trouble pond, wetlands are immediately adjacent to the site in all

directions. It is currently believed, however, that the proposed restoration work could be performed within the existing structures and access road; no vegetated wetlands would be directly affected.

4.20.3 Water Quality

Surface water quality was measured at three locations on the 33-17 site and within the near watershed (refer to Section 2.2 for a description of the equipment used); Table 4-18 presents results. In addition, physical stream habitat assessments were conducted at two locations on Cedar Creek, one upstream and one downstream of the Double Trouble dam. (Refer to Appendix B for field data sheets).

Table 4-18. Results of water quality testing done at Site 33-17 (Double Trouble dam) for the Barnegat Environmental Testing field studies.

Sampling Location	pH	Salinity (o/oo)	D.O. (mg/L)	Specific Conductivity (mS/cm)	Temp (°C)	Turbidity (NTU)
W1 (SW edge of D.T. pond, near dam; surface)	4.11	0.02	8.76	0.051	17.93	18.9
W2 (Cedar Creek, downst.of D.T. dam; surface)	4.07	0.01	10.28	0.033	17.37	17.8
W3 (Cedar Creek, upstr. of D.T. dam; surface)	3.90	0.01	9.68	0.032	17.46	18.7

Several items of note were discovered during the water quality data collection in the vicinity of 33-17. The pH of Cedar Creek was very acidic; it possessed an average pH of about 4.0 in the area of the site, and was only 3.9 in some areas of the headwaters. The water temperature in the headwaters of the creek was relatively cool (at about 17.5 °C), and could be considered a cool water system; flow was also relatively swift. The water temperature was only slightly warmer in the large Double Trouble pond. Dissolved oxygen was relatively high throughout the system (refer to NWS03 data sheets, Appendix B). No eutrophication was evident in the Double Trouble pond at the 33-17 site.

Physical habitats in the headwaters of Cedar Creek are of relatively high quality, appear to be well-protected within the state park, and with a few minor exceptions, are generally well-buffered from roads and development. Both the upstream and downstream habitats rated “optimal” for all categories (epifaunal substrate/available cover; pool substrate characterization; pool variability; sediment deposition; channel flow status; channel alteration; channel sinuosity; bank stability; vegetative protection; and riparian vegetative zone width), with the exception of channel sinuosity (the Double

Trouble dam has definitely had a modest negative effect on both upstream and downstream habitats). The creek possessed a relatively strong flow, apparently good water quality (with the exception of the very high acidity), and was well-buffered; a number of fish and invertebrates were observed in the creek (see Wildlife, below).

4.20.4 Wildlife

Wildlife and their signs (tracks, scats, calls, and other identifiable physical evidence) were observed at and near site 33-17 while conducting the field studies. These included mallard duck (*Anas platyrhynchos*), white-eyed vireo (*Vireo griseus*), ovenbird (*Seiurus aurocapillus*), prairie warbler (*Dendroica discolor*), pine warbler (*Dendroica pinus*), rufous-sided towhee (*Pipilo erythropthalmus*), American eel (*Anguilla rostrata*), grass pickerel (*Esox vermiculatus*), and several unidentified species of caddis flies, dragonflies, mayflies, and diving beetles. With the exception of several mallard ducks observed on the pond behind the dam, all of the other birds were observed or heard in the upland oak/pine forest to the southeast of the dam. The pond was virtually absent of aquatic birds during the field studies.

4.20.5 Environmental Problems at the Site

Loss of Habitat from Other Hydrological Modifications

The construction of berms and placement of water control structures for cranberry production at the site flooded valuable stream, wetland, and upland habitats and replaced them with relatively sterile open water habitats. A significant amount of Atlantic white cedar wetlands were apparently lost by flooding of the ponds and stream habitats. The water control structures also serve as barriers to anadromous (herring), catadromous (eel), and resident fish populations on Cedar Creek. The open water habitats may provide a very poor fishery and appear to be surprisingly little-used by ducks, waterfowl, and other wildlife.

Degradation of Water Quality

Ponded, converted stream habitats such as 33-17 add to the deterioration of local water quality in Cedar Creek, and ultimately in the Bay. This is primarily because they are broad, poorly-flushed environments where dissolved oxygen is lowered, and temperatures and nutrient levels are raised. In addition, the physical habitats of Cedar Creek have been altered immediately above and below the site, further exacerbating water quality problems. The natural Atlantic white cedar wetlands that protected water quality and buffered the creek were largely removed and replaced with the large open water ponds as part of the former cranberry bog operation.

4.20.6 Restoration Constraints and Other Site Information

The primary constraint with regard to anadromous fishery issues is the water chemistry at and upstream of the site. The pH is very low (about 4.0 in many areas, and 3.9 upstream of the site); there has been discussion regarding the potential success of the

fishery in such acid conditions. Almost no historic information exists on the anadromous fishery in the creek, although Zich (1977) cites the presence of alewife below the project. Prior to establishing final restoration plans for the site, it would be critical to perform further data-gathering on pH on the creek, as well as gill-netting to determine the current status of alewife and other fish in the system. On the other hand, the physical habitat upstream of 33-17 appears to be of high quality. Finally, while the anadromous fishery would definitely be constrained by water chemistry, passage at site 33-17 would also provide for free movement of other native non-anadromous and catadromous fish and benthos.

4.20.7 Restoration Concept

The concepts for restoration at 33-17 involve establishment of an anadromous fishery in Cedar Creek. Other benefits would likely be realized as part of the restoration, including freedom of movement for non-anadromous fish and benthos, and improved water quality and physical stream habitat.

The existing main water control structure and spillway would be retrofitted with a pre-fabricated fish passage structure. Few other physical changes would have to be done to the existing facilities to establish the anadromous fishery. After installation of the ladder, the creek would have to be "seeded" by hatchery fish for at least 3 years prior to establishment of an anadromous population of alewife.

4.20.8 Project Implementation

The existing water control structure and spillway would be retrofitted with a pre-fabricated fish passage structure. Because the new structure could be installed from the existing roadways, no existing wetland, aquatic, or terrestrial communities would likely be affected by their installation or operation. It is assumed at this time that the fish ladder structure would be prefabricated and would be installed for a lump sum. The use of best management practices and soil erosion and sediment control techniques would minimize the temporary impacts to Cedar Creek during the construction process. It is assumed at this time that the approximately 3-year process of "seeding" alewife fry above the Double Trouble Dam site would be performed by the Division of Fish and Wildlife; the implementation and costs for this aspect of the restoration would be incurred by the Division.

Monitoring and maintenance of the restored 33-17 site will require long-term (but not necessarily complex) studies of the anadromous fishery.

4.20.9 Potential Environmental Impacts

Because of the specific nature of the existing Double Trouble Dam site and the proposed elements of restoration (the fish passage facility would likely be installed within the existing concrete spillway and water control structure), it is presumed that the restoration could be performed with a minimum of ecological impact to the aquatic and

terrestrial environments. On the contrary, installation of the fish ladder structure would provide passage of both anadromous and non-anadromous fish, allowing for the potential movement of these fish from the Bay into the headwaters of Cedar Creek and back.

With implementation of appropriate best management practices and soil erosion and sediment control measures, the proposed activities would likely pose minimal impacts on the existing ecological resources. Such measures could include use of silt curtains, hay bales, temporary seeding of exposed slopes, etc.

Implementation of the project would not likely result in any additional significant positive or negative impacts relating to air quality and noise levels, water quality, wetlands and other special aquatic areas, finfish, including Essential Fish Habitat, wildlife resources including, but not limited to, the target species that have been identified, and threatened and endangered species.

4.20.10 Estimated Costs

The following approximate estimated costs relate to the principal elements of the project implementation at site 33-17, as stated above. The costs listed are approximate only, subject to change, and are primarily intended to provide perspective of the relative magnitude of the project. In addition to the specified costs, additional costs ranging from roughly $2,000 to $20,000 would likely need to be spent for seeding the watershed above Stafford Forge with gravid adult alewife. These costs, to be incurred by the NJDEP Division of Fish and Wildlife, will vary greatly, depending on conditions present during collection of fish in preparation for the seeding. It must also be noted that where a range of costs for each item was available, the maximum cost was used.

Installation of pre-fabricated fish ladder structure:
1 structure and labor = $100,000

Monitoring and maintenance:
Site inspections and monitoring: $800.00 X 6 visits = $4,800.00

GRAND TOTAL = $104,800

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5.0 LITERATURE CITED

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APPENDIX A

CORRESPONDENCE, MEETING MINUTES, AND OTHER CONTACT INFORMATION

State of New Jersey

Christine Todd Whitman
Governor

Department of Environmental Protection
New Jersey Division of Fish and Wildlife
Assunpink Wildlife Management Area
386 Clarksburg-Robbinsville Road
Robbinsville, NJ 08691
Tel. 609-259-2132
www.state.nj.us/dep/fgw

Robert C. Shinn, Jr.
Commissioner

July 18, 2000

Steve Harrriott
Professional Wetland Scientist
Versar Inc.
9200 Rumsey Road
Columbia, Maryland 21045-1934

Dear Mr. Harriott:

The New Jersey Division of Fish and Wildlife is presently developing a scope of work to replace the wooden spillway adjacent to Forge Road. Funding has already been secured for this project. Our long-range plans include hiring a conservation engineer to evaluate a new plan to replace all the existing spillway structures. Many of the existing structures are severely deteriorated and need immediate replacement. Funding has not been allocated for the second phase of this project.

The proposal to restore Atlantic white cedar wetlands and the anadromous fishery to Westecunk Creek is an excellent project. It is my recommendation that Versar and Division staff meet to discuss this proposal in more detail. Division waterfowl and fisheries biologists should be present at this meeting. The Division has incurred significant historical costs in the development of this diking system.

The regional superintendent should also be involved in this planning meeting. It is extremely important that we initiate this meeting as soon as possible, because of the development of a new project to replace the lower spillway structure. Fish ladder considerations will need to be discussed.

If you have any additional questions, please contact me at 609-259-2132.

Sincerely,

Raymond J. Porutski

Raymond J. Porutski
Regional Superintendent

Cc: A. Petrongolo
P. Castelli
H. Carberry
D. Wilkinson
A. Didun

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Natural Heritage Priority Site

Manahawkin Bay Macrosite

Locational Information

Quad Name: Ship Bottom ; Long Beach Ne ; Beach Haven ; Tuckerton

County: Ocean

Municipality: Barnegat Light Boro ; Beach Haven Boro ; Long Beach Twp ; Ship Bottom Boro ; Stafford Twp ; Surf City Boro ; Barnegat Twp ; Harvey Cedars Boro ; Little Egg Harbor Twp

Description of Site

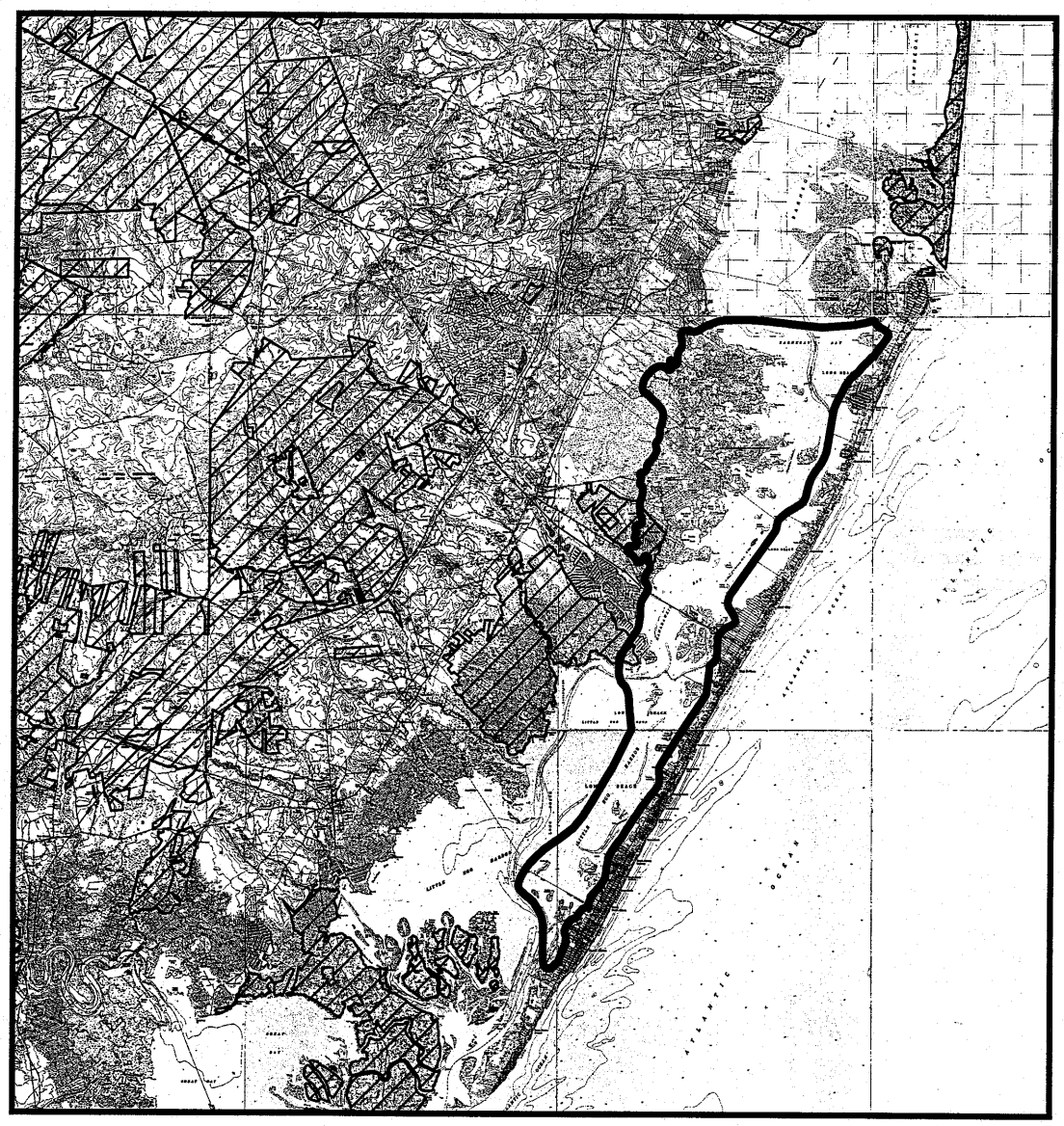
A large stretch of back bay and salt marsh islands providing habitat to many rare colonial waterbirds.

Boundary Justification

Bounds enclose marsh breeding habitat for a concentration of State endangered and threatened colonial waterbirds.

Biodiversity Rank B5

The site contains breeding habitat for many State Endangered and Threatened colonial waterbirds.



Natural Heritage Priority Site

Manahawkin Bay Macrosite

Ocean County

NJ Department of Environmental Protection
Division of Parks and Forestry
Natural Lands Management

2 0 2 Miles

Priority Site
Public Land

N W E S

Natural Heritage Priority Site

Ballanger Creek

Locational Information

Quad Name: New Gretna
County: Ocean ; Burlington
Municipality: Egg Harbor Twp ; Bass River Twp

Description of Site

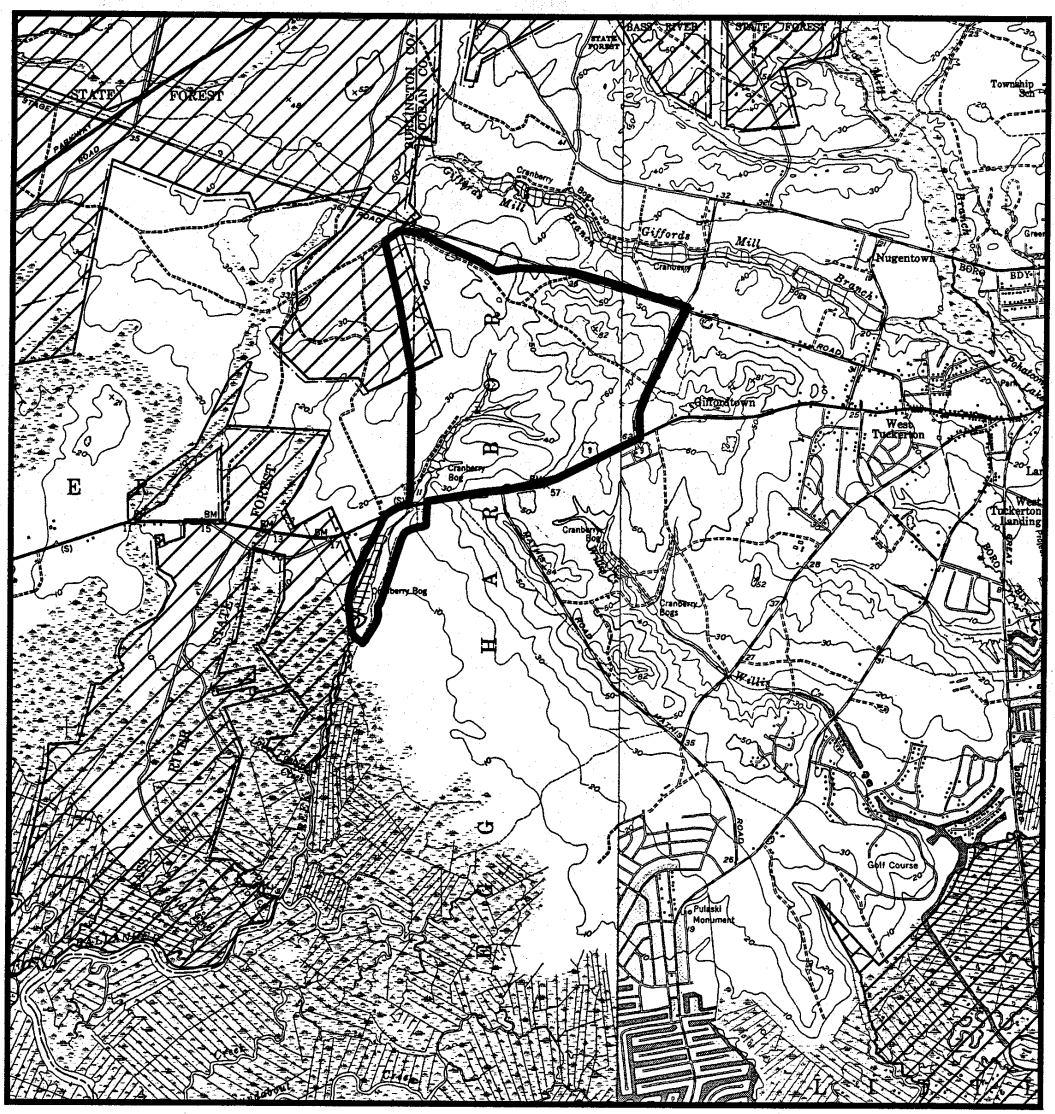
Abandoned cranberry bogs.

Boundary Justification

Boundary drawn to include extent of species' occurrences plus upland buffer within the drainage basin.

Biodiversity Rank B4

Contains a population of a globally rare State-listed Endangered Plant Species and one special concern plant.



Natural Heritage Priority Site

Ballanger Creek

Burlington and Ocean Counties

NJ Department of Environmental Protection
Division of Parks and Forestry
Natural Lands Management

0.4 0 0.4 Miles

Priority Site
Public Land

N W E S

Natural Heritage Priority Site

East Plains Fireshed

Locational Information

Quad Name: West Creek ; Oswego Lake ; Brookville
County: Burlington ; Ocean
Municipality: Bass River Twp ; Eagleswood Twp ; Little Egg Harbor Twp ; Stafford Twp ; Barnegat Twp

Description of Site

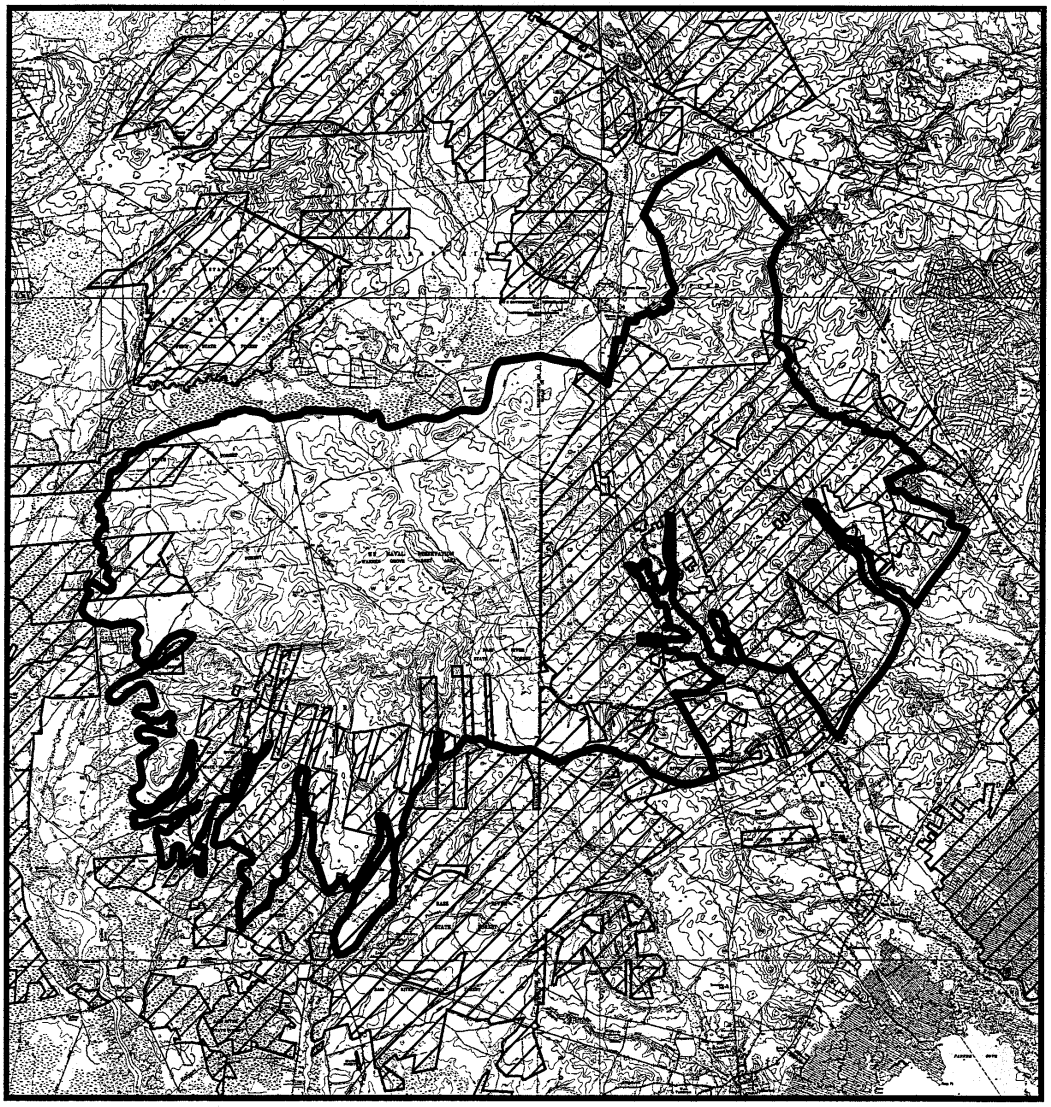
A large patch of pitch pine-shrub oak barrens and pine plains in broad sandy uplands, interrupted by few wetlands.

Boundary Justification

Bounds drawn to include the fireshed containing the majority of fires that burn into the East Plains. Includes highly flammable pitch pine-shrub oak barrens and pine plains vegetation. Bordered by broad patches of wetlands or major roads or mesic forests which act as firebreaks.

Biodiversity Rank B1

This macrosite contains a globally imperiled natural community and a number of globally rare plants and animals. The site contains the land that supports the fire regime that sustains the pine plains vegetation of the East Plains.



Natural Heritage Priority Site

East Plains Fireshed

Burlington and Ocean Counties

NJ Department of Environmental Protection
Division of Parks and Forestry
Natural Lands Management

2 0 2 Miles

Priority Site
Public Land

N W E S

Natural Heritage Priority Site

Island Beach Macrosite

Locational Information

Quad Name: Barnegat Light ; Forked River ; Seaside Park
County: Ocean
Municipality: Berkeley Twp ; Barnegat Light Boro ; Lacey Twp ; Long Beach Twp ; Ocean Twp

Description of Site

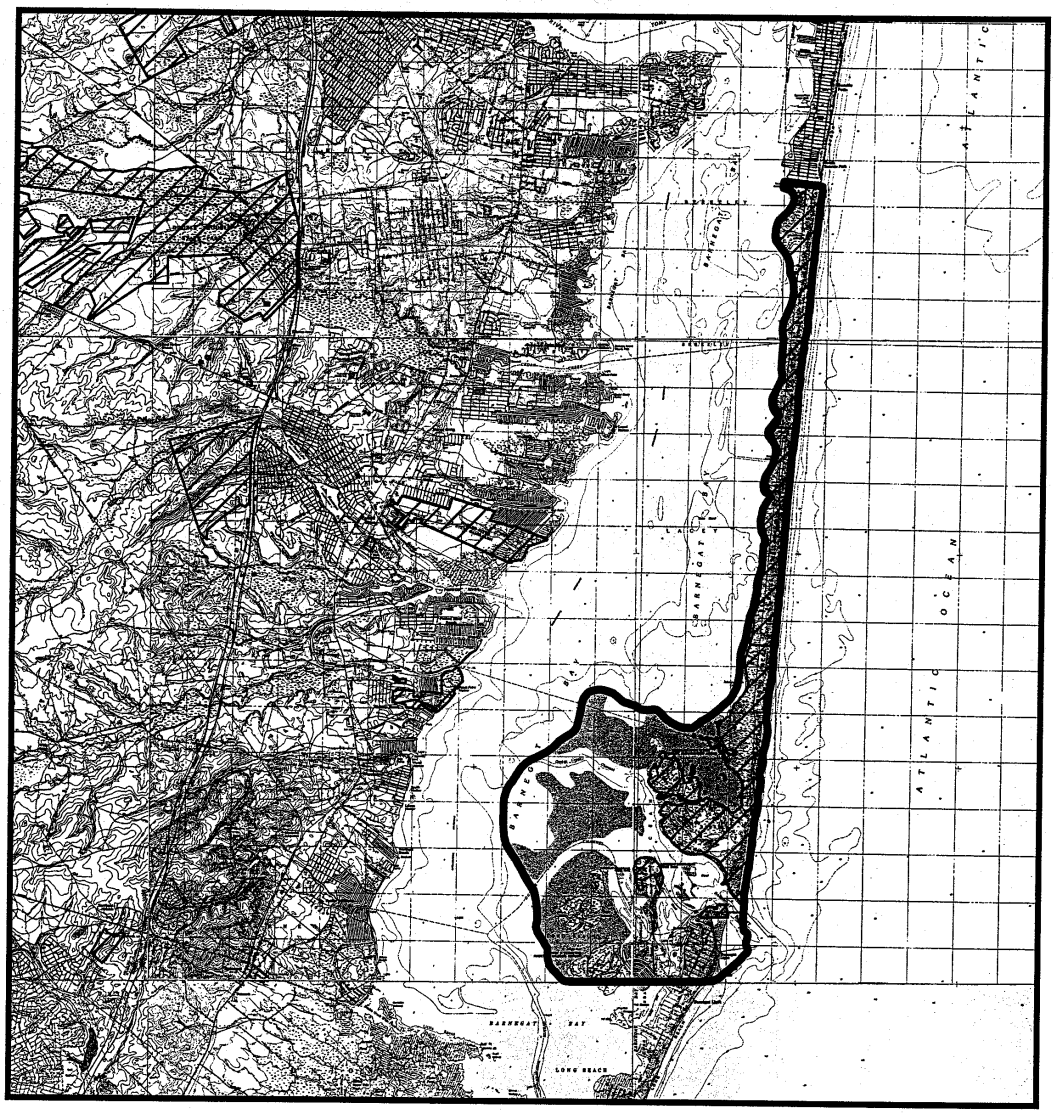
Large expansive beaches, dunes and wetlands on and adjacent to Island Beach State Park and on the northern tip of Long Beach Island.

Boundary Justification

Boundaries include extensive beach, dune and marsh habitats for rare birds, plants and natural communities. Primary bounds should exclude developed portions of Barnegat Light.

Biodiversity Rank B2

The site contains populations of several globally rare and state rare endangered and threatened animals, plants, and natural communities.



Natural Heritage Priority Site

Island Beach Macrosite

Ocean County

NJ Department of Environmental Protection
Division of Parks and Forestry
Natural Lands Management

2 0 2 Mile

Priority Site
Public Land

N W E S

Natural Heritage Priority Site

Cedar Bonnet Island

Locational Information

Quad Name: Ship Bottom
County: Ocean
Municipality: Stafford Twp

Description of Site

The site is the southern portion of Cedar Bonnet Island (the northern boundary being Rt. 72) which includes tidal salt marsh habitat in the Manahawkin Bay.

Boundary Justification

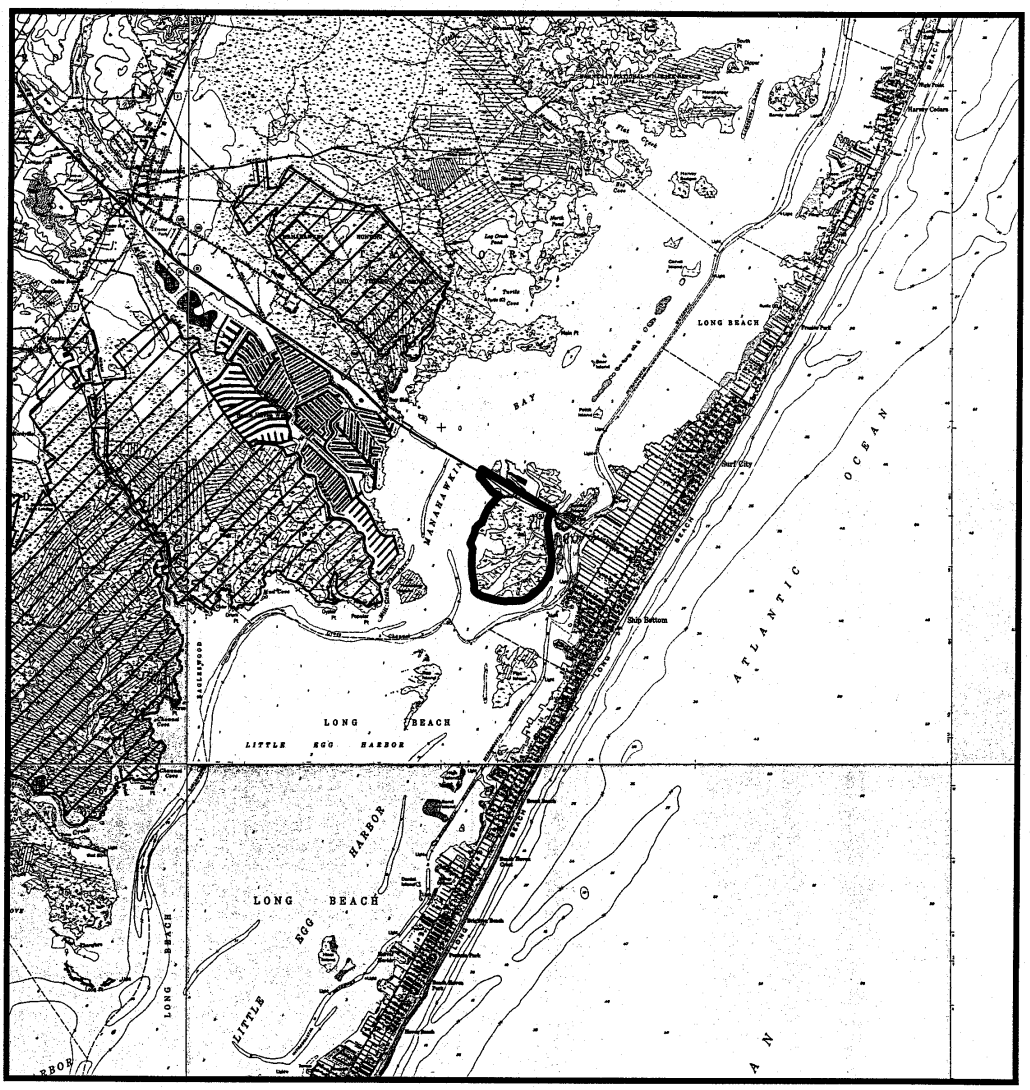
Boundaries drawn to include habitat for various bird species.

Biodiversity Rank ***B4***

The site contains nesting habitat for a globally rare State endangered bird species and four other State endangered bird species.

NJ Department of Environmental Protection
Division of Parks and Forestry
Natural Lands Management

June, 1999
Site Code: S.USNJHP1*163



Natural Heritage Priority Site

Cedar Bonnet Island

Ocean County

NJ Department of Environmental Protection
Division of Parks and Forestry
Natural Lands Management

0.9 0 0.9 Miles

Priority Site
Public Land

N W E S

Natural Heritage Priority Site

Sedge Islands At Island Beach

Locational Information

Quad Name: Barnegat Light
County: Ocean
Municipality: Berkeley Twp ; Ocean Twp ; Lacey Twp ; Long Beach Twp

Description of Site

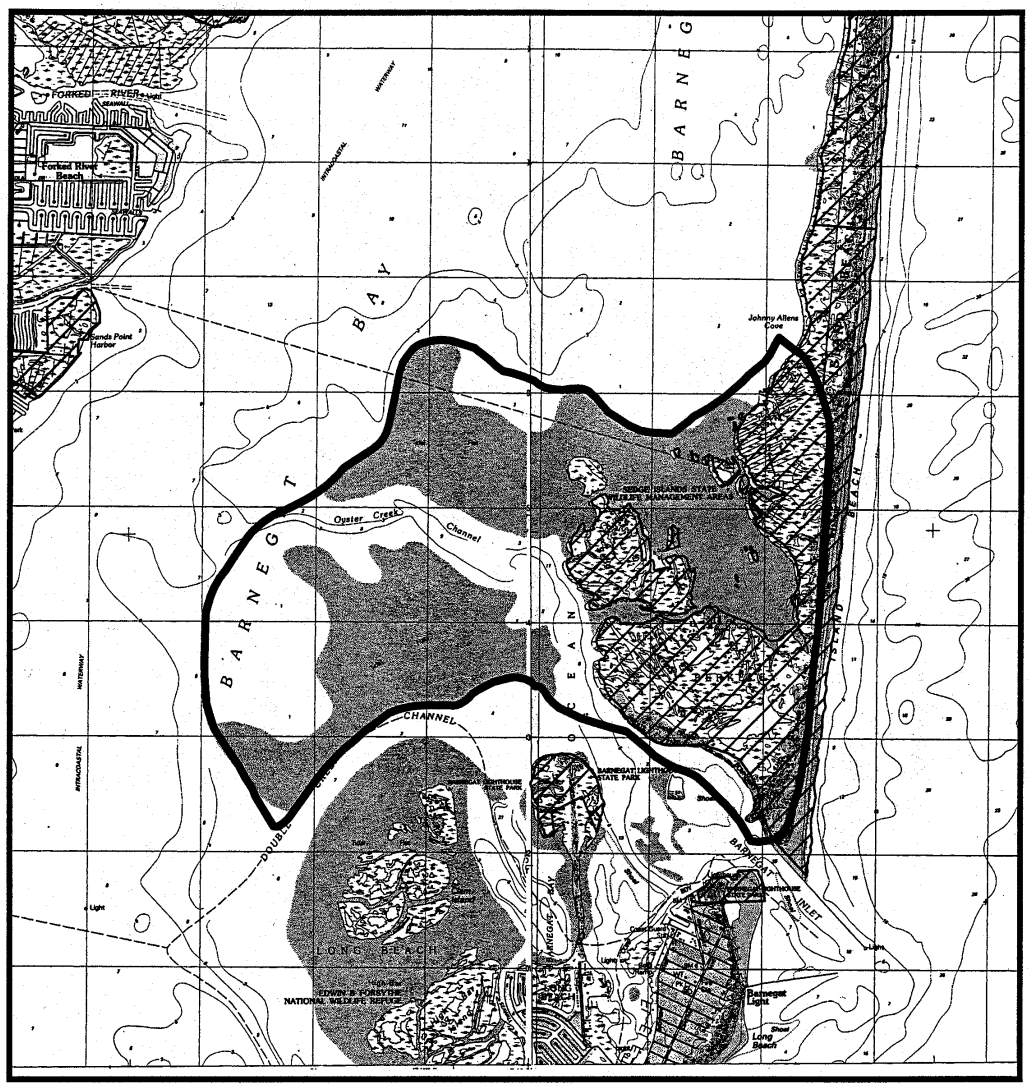
Tidal salt marsh and marsh islands on Barnegat Bay, at the southern end of Island Beach. Osprey nest structures are platforms and poles.

Boundary Justification

Boundaries drawn to include tidal salt marsh and dune habitat that provide habitat for bird species.

Biodiversity Rank **B4**

Site contains 2 globally rare State endangered bird species and 1 globally rare State endangered reptilian species. Also contains several additional State endangered or threatened bird species.



Natural Heritage Priority Site

Sedge Islands at Island Beach

Ocean County

NJ Department of Environmental Protection
Division of Parks and Forestry
Natural Lands Management

0.6 0 0.6 Miles

Priority Site
Public Land

N W E S

Natural Heritage Priority Site

Barnegat Light Site

Locational Information

Quad Name: Barnegat Light
County: Ocean
Municipality: Barnegat Light Boro

Description of Site

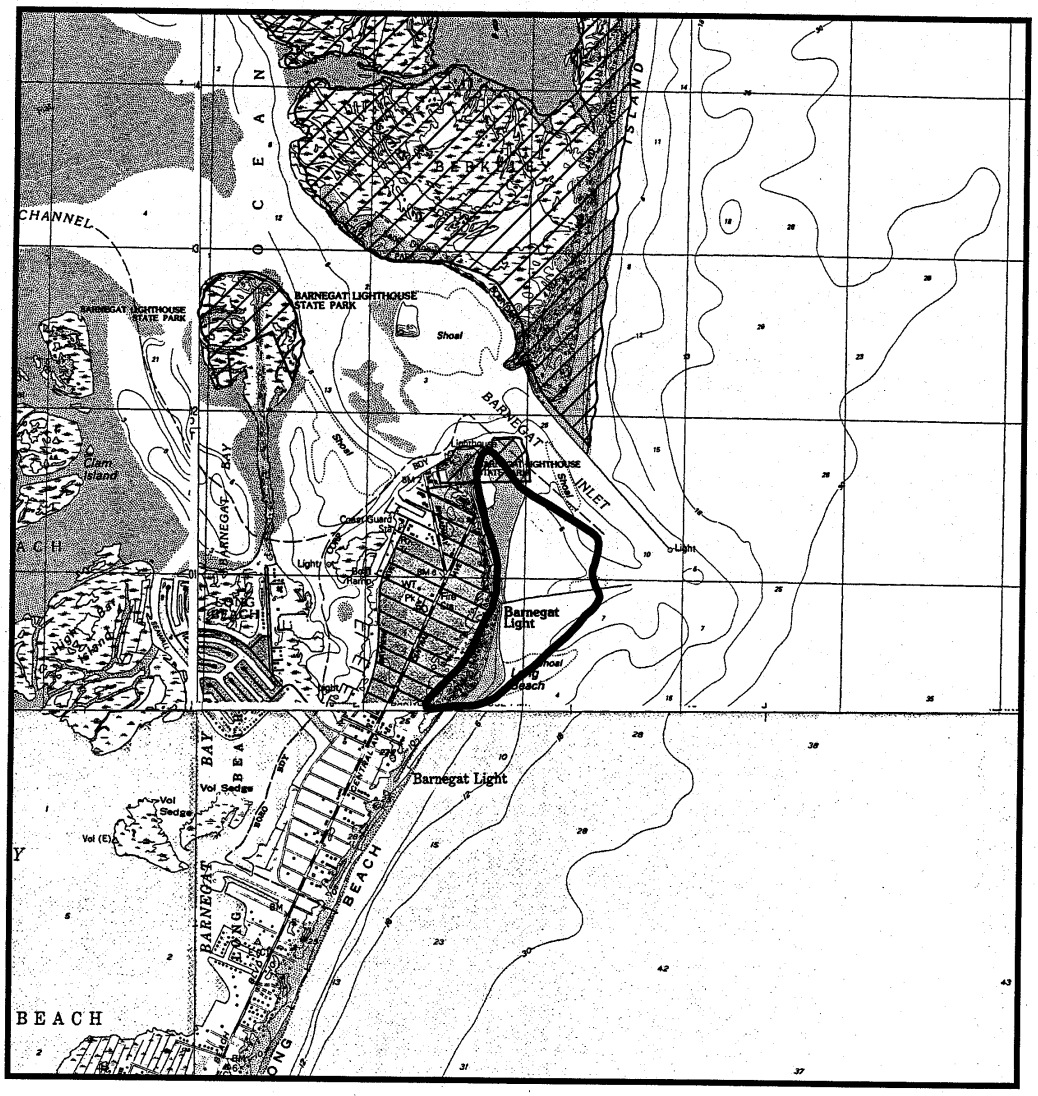
Coastal barrier beach at the northern portion of Long Beach Island, including a spoil island and a newly formed sandy area created by the deposition and accretion of sand along the new jetty.

Boundary Justification

Bounds drawn to include beaches and dunes which are critical habitat for the bird species.

Biodiversity Rank B2

Contains an excellent population of a globally rare State Endangered bird species, and several other populations of State Endangered birds.



Natural Heritage Priority Site

Barnegat Light Site

Ocean County

NJ Department of Environmental Protection
Division of Parks and Forestry
Natural Lands Management

0.4 0 0.4 Miles

Priority Site
Public Land

N W E S

EXPLANATIONS OF CODES USED IN NATURAL HERITAGE REPORTS

FEDERAL STATUS CODES

The following U.S. Fish and Wildlife Service categories and their definitions of endangered and threatened plants and animals have been modified from the U.S. Fish and Wildlife Service (F.R. Vol. 50 No. 188; Vol. 61, No. 40; F.R. 50 CFR Part 17). Federal Status codes reported for species follow the most recent listing.

LE	Taxa formally listed as endangered.
LT	Taxa formally listed as threatened.
PE	Taxa already proposed to be formally listed as endangered.
PT	Taxa already proposed to be formally listed as threatened.
C	Taxa for which the Service currently has on file sufficient information on biological vulnerability and threat(s) to support proposals to list them as endangered or threatened species.
S/A	Similarity of appearance species.

STATE STATUS CODES

Two animal lists provide state status codes after the Endangered and Nongame Species Conservation Act of 1973 (NSSA 23:2A-13 et. seq.): the list of endangered species (N.J.A.C. 7:25-4.13) and the list defining status of indigenous, nongame wildlife species of New Jersey (N.J.A.C. 7:25-4.17(a)). The status of animal species is determined by the Nongame and Endangered Species Program (ENSP). The state status codes and definitions provided reflect the most recent lists that were revised in the New Jersey Register, Monday, June 3, 1991.

D	Declining species-a species which has exhibited a continued decline in population numbers over the years.
E	Endangered species-an endangered species is one whose prospects for survival within the state are in immediate danger due to one or many factors - a loss of habitat, over exploitation, predation, competition, disease. An endangered species requires immediate assistance or extinction will probably follow.
EX	Extirpated species-a species that formerly occurred in New Jersey, but is not now known to exist within the state.
I	Introduced species-a species not native to New Jersey that could not have established itself here without the assistance of man.
INC	Increasing species-a species whose population has exhibited a significant increase, beyond the normal range of its life cycle, over a long term period.
T	Threatened species-a species that may become endangered if conditions surrounding the species begin to or continue to deteriorate.
P	Peripheral species-a species whose occurrence in New Jersey is at the extreme edge of its present natural range.
S	Stable species-a species whose population is not undergoing any long-term increase/decrease within its natural cycle.
U	Undetermined species-a species about which there is not enough information available to determine the status.

Status for animals separated by a slash(/) indicate a duel status. First status refers to the state breeding population, and the second status refers to the migratory or winter population.

Plant taxa listed as endangered are from New Jersey's official Endangered Plant Species List N.J.S.A. 131B-15.151 et seq.

E Native New Jersey plant species whose survival in the State or nation is in jeopardy.

REGIONAL STATUS CODES FOR PLANTS

LP Indicates taxa listed by the Pinelands Commission as endangered or threatened within their legal jurisdiction. Not all species currently tracked by the Pinelands Commission are tracked by the Natural Heritage Program. A complete list of endangered and threatened Pineland species is included in the New Jersey Pinelands Comprehensive Management Plan.

EXPLANATION OF GLOBAL AND STATE ELEMENT RANKS

The Nature Conservancy has developed a ranking system for use in identifying elements (rare species and natural communities) of natural diversity most endangered with extinction. Each element is ranked according to its global, national, and state (or subnational in other countries) rarity. These ranks are used to prioritize conservation work so that the most endangered elements receive attention first. Definitions for element ranks are after The Nature Conservancy (1982: Chapter 4, 4.1-1 through 4.4.1.3-3).

GLOBAL ELEMENT RANKS

G1 Critically imperiled globally because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extinction.

G2 Imperiled globally because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extinction throughout its range.

G3 Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range (e.g., a single western state, a physiographic region in the East) or because of other factors making it vulnerable to extinction throughout it's range; with the number of occurrences in the range of 21 to 100.

G4 Apparently secure globally; although it may be quite rare in parts of its range, especially at the periphery.

G5 Demonstrably secure globally; although it may be quite rare in parts of its range, especially at the periphery.

GH Of historical occurrence throughout its range i.e., formerly part of the established biota, with the expectation that it may be rediscovered.

GU Possibly in peril range-wide but status uncertain; more information needed.

GX Believed to be extinct throughout range (e.g., passenger pigeon) with virtually no likelihood that it will be rediscovered.

G? Species has not yet been ranked.

STATE ELEMENT RANKS

S1 Critically imperiled in New Jersey because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres).

Elements so ranked are often restricted to very specialized conditions or habitats and/or restricted to an extremely small geographical area of the state. Also included are elements which were formerly more abundant, but because of habitat destruction or some other critical factor of its biology, they have been demonstrably reduced in abundance. In essence, these are elements for which, even with intensive searching, sizable additional occurrences are unlikely to be discovered.

S2 Imperiled in New Jersey because of rarity (6 to 20 occurrences). Historically many of these elements may have been more frequent but are now known from very few extant occurrences, primarily because of habitat destruction. Diligent searching may yield additional occurrences.

S3 Rare in state with 21 to 100 occurrences (plant species in this category have only 21 to 50 occurrences). Includes elements which are widely distributed in the state but with small populations/acreage or elements with restricted distribution, but locally abundant. Not yet imperiled in state but may soon be if current trends continue. Searching often yields additional occurrences.

S4 Apparently secure in state, with many occurrences.

S5 Demonstrably secure in state and essentially ineradicable under present conditions.

SA Accidental in state, including species (usually birds or butterflies) recorded once or twice or only at very great intervals, hundreds or even thousands of miles outside their usual range; a few of these species may even have bred on the one or two occasions they were recorded; examples include European strays or western birds on the East Coast and vice-versa.

SE Elements that are clearly exotic in New Jersey including those taxa not native to North America (introduced taxa) or taxa deliberately or accidentally introduced into the State from other parts of North America (adventive taxa). Taxa ranked SE are not a conservation priority (viable introduced occurrences of G1 or G2 elements may be exceptions).

SH Elements of historical occurrence in New Jersey. Despite some searching of historical occurrences and/or potential habitat, no extant occurrences are known. Since not all of the historical occurrences have been field surveyed, and unsearched potential habitat remains, historically ranked taxa are considered possibly extant, and remain a conservation priority for continued field work.

SP Element has potential to occur in New Jersey, but no occurrences have been reported.

SR Elements reported from New Jersey, but without persuasive documentation which would provide a basis for either accepting or rejecting the report. In some instances documentation may exist, but as of yet, its source or location has not been determined.

SRF Elements erroneously reported from New Jersey, but this error persists in the literature.

SU Elements believed to be in peril but the degree of rarity uncertain. Also included are rare taxa of uncertain taxonomical standing. More information is needed to resolve rank.

SX Elements that have been determined or are presumed to be extirpated from New Jersey. All historical occurrences have been searched and a reasonable search of potential habitat has been completed. Extirpated taxa are not a current conservation priority.

SXC Elements presumed extirpated from New Jersey, but native populations collected from the wild exist in cultivation.

SZ Not of practical conservation concern in New Jersey, because there are no definable occurrences, although the taxon is native and appears regularly in the state. An SZ rank will generally be used for long distance migrants whose occurrences during their migrations are too irregular (in terms of repeated visitation to the same locations), transitory, and dispersed to be reliably identified, mapped and

protected. In other words, the migrant regularly passes through the state, but enduring, mappable element occurrences cannot be defined.

Typically, the SZ rank applies to a non-breeding population (N) in the state - for example, birds on migration. An SZ rank may in a few instances also apply to a breeding population (B), for example certain lepidoptera which regularly die out every year with no significant return migration.

Although the SZ rank typically applies to migrants, it should not be used indiscriminately. Just because a species is on migration does not mean it receives an SZ rank. SZ will only apply when the migrants occur in an irregular, transitory and dispersed manner.

B Refers to the breeding population of the element in the state.

N Refers to the non-breeding population of the element in the state.

T Element ranks containing a "T" indicate that the infraspecific taxon is being ranked differently than the full species. For example *Stachys palustris* var. *homotricha* is ranked "G5T? SH" meaning the full species is globally secure but the global rarity of the var. *homotricha* has not been determined; in New Jersey the variety is ranked historic.

Q Elements containing a "Q" in the global portion of its rank indicates that the taxon is of questionable, or uncertain taxonomical standing, e.g., some authors regard it as a full species, while others treat it at the subspecific level.

.1 Elements documented from a single location.

Note: To express uncertainty, the most likely rank is assigned and a question mark added (e.g., G2?). A range is indicated by combining two ranks (e.g., G1G2, S1S3).

IDENTIFICATION CODES

These codes refer to whether the identification of the species or community has been checked by a reliable individual and is indicative of significant habitat.

Y Identification has been verified and is indicative of significant habitat.

BLANK Identification has not been verified but there is no reason to believe it is not indicative of significant habitat.

? Either it has not been determined if the record is indicative of significant habitat or the identification of the species or community may be confusing or disputed.

Revised September 1995

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	NAME	COMMON NAME	FEDERAL STATUS	STATE STATUS	REGIONAL STATUS	GRANK	SRANK
*** Vertebrates							
	ACCIPITER COOPERII	COOPER'S HAWK		T/T		G5	S3B,S4N
	AMBYSTOMA TIGRINUM TIGRINUM	EASTERN TIGER SALAMANDER		E		G5T5	S2
	AMMODRAMUS SAVANNARUM	GRASSHOPPER SPARROW		T/S		G5	S2B
	ARDEA HERODIAS	GREAT BLUE HERON		S/S		G5	S2B,S4N
	BARTRAMIA LONGICAUDA	UPLAND SANDPIPER		E		G5	S1B
	CHARADRIUS MELODUS	PIPING PLOVER	LT	E		G3	S1B
	CIRCUS CYANEUS	NORTHERN HARRIER		E/U		G5	S1B,S3N
	CISTOTHORUS PLATENSIS	SEDGE WREN		E		G5	S1B
	CLEMMYS INSCULPTA	WOOD TURTLE		T		G4	S3
	CLEMMYS MUHLENBERGII	BOG TURTLE	LT	E		G3	S2
	CROTALUS HORRIDUS HORRIDUS	TIMBER RATTLESNAKE		E		G4T4	S2
	EGRETTA CAERULEA	LITTLE BLUE HERON		S/S		G5	S2B
	EGRETTA THULA	SNOWY EGRET		S/S		G5	S3B,S4N
	EGRETTA TRICOLOR	TRICOLORED HERON		INC/S		G5	S1B
	ELAPHE GUTTATA GUTTATA	CORN SNAKE		E		G5T5	S1
	EUMECES FASCIATUS	FIVE-LINED SKINK		U		G5	S3
	FALCO PEREGRINUS	PEREGRINE FALCON		E		G4	S1B,S?N
	HALIAEETUS LEUCOCEPHALUS	BALD EAGLE	LT	E		G4	S1B,S2N
	HYLA ANDERSONII	PINE BARRENS TREEFROG		E		G4	S3
	HYLA CHRYSOSCELIS	COPE'S GRAY TREEFROG		E		G5	S2
	LATERALLUS JAMAICENSIS	BLACK RAIL		T/T		G4	S2B
	LYNX RUFUS	BOBCAT		E		G5	S3
	MELANERPES ERYTHROCEPHALUS	RED-HEADED WOODPECKER		T/T		G5	S2B,S2N
	NYCTANASSA VIOLACEA	YELLOW-CROWNED NIGHT-HERON		T/T		G5	S2B
	NYCTICORAX NYCTICORAX	BLACK-CROWNED NIGHT-HERON		T/S		G5	S3B,S4N
	PANDION HALIAETUS	OSPREY		T/T		G5	S2B
	PITUOPHIS MELANOLEUCUS MELANOLEUCUS	NORTHERN PINE SNAKE		T		G4T4	S3
	PLEGADIS FALCINELLUS	GLOSSY IBIS		D/S		G5	S3B,S4N

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NAME	COMMON NAME	FEDERAL STATUS	STATE STATUS	REGIONAL STATUS	GRANK	SRANK
PODILYMBUS PODICEPS	PIED-BILLED GREBE		E/S		G5	S1B,S3N
POOECETES GRAMINEUS	VESPER SPARROW		E		G5	S1B,S2N
RYNCHOPS NIGER	BLACK SKIMMER		E		G5	S1B
STERNA ANTILLARUM	LEAST TERN		E		G4	S1B
STERNA DOUGALLII DOUGALLII	ROSEATE TERN	LE	E		G4T3	SHB
STERNA HIRUNDO	COMMON TERN		D/S		G5	S3B
STERNA NILOTICA	GULL-BILLED TERN		S		G5	S1B
STRIX VARIA	BARRED OWL		T/T		G5	S3B
SYNAPTOMYS COOPERI	SOUTHERN BOG LEMMING		U		G5	S2
*** Ecosystems						
COASTAL DUNE SHRUBLAND	COASTAL DUNE SHRUBLAND				G4	S2?
COASTAL DUNE WOODLAND	COASTAL DUNE WOODLAND				G2G3	S1
MARINE INTERTIDAL GRAVEL/SAND	MARINE INTERTIDAL GRAVEL/SAND				GU	SU
BEACH COMMUNITY	BEACH COMMUNITY					
PINE PLAINS	DWARF PITCH PINE-BLACKJACK OAK PINE PLAINS				G1	S1
PINUS RIGIDA-CALAMOVILFA BREVIPILIS SAVANNA	PITCH PINE-PINELANDS REEDGRASS SAVANNA				G1	S1
*** Invertebrates						
ACRONICTA ALBARUFA	BARRENS DAGGER MOTH				G3G4	SU
AESHNA CLEPSYDRA	MOTTLED DARNER				G4	S2S3
AGROTIS BUCHHOLZI	BUCHHOLZ'S DART MOTH				G2	S2
APHARETRA DENTATA	A NOCTUID MOTH				G4	S2S3
ATRYTONE AROGOS AROGOS	AROGOS SKIPPER				G3G4T1T2	S1
BOLORIA SELENE MYRINA	A SILVER-BORDERED FRITILLARY				G5T5	S2
CALLOPHRYS HENRICI	HENRY'S ELFIN				G5	S3S4
CALLOPHRYS HESSELI	HESSEL'S HAIRSTREAK				G3G4	S3S4
CALLOPHRYS IRUS	FROSTED ELFIN				G3	S2S3

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NAME	COMMON NAME	FEDERAL STATUS	STATE STATUS	REGIONAL STATUS	GRANK	SRANK
CALLOPHRYS POLIOS	HOARY ELFIN				G5	S3
CALLOPISTRIA GRANITOSA	GRANITOSA FERN MOTH				G4G5	S2S3
CATOCALA NERODIAS GERHARDI	HERODIAS UNDERWING				G3T3	S3
CATOCALA JAIR SSP 2					G4T4	S3
CELITHEMIS MARTHA	MARTHA'S PENNANT				G4	S3S4
CICINDELA DORSALIS DORSALIS	NORTHEASTERN BEACH TIGER BEETLE	LT	E		G4T2	S1
CICINDELA PATRUELA CONSENTANEA	A TIGER BEETLE				G1T2	S2S3
CRAMBUS DAECKELLUS	DAECKE'S PYRALID MOTH				G1G3	S1S3
DATANA RANAECEPS	A HAND-MAID MOTH				G1G4	S3S4
ENALLAGMA PICTUM	SCARLET BLUET				G3	S3
ENALLAGMA RECURVATUM	PINE BARRENS BLUET				G3	S3
ERYNNIS PERSIUS PERSIUS	A PERSIUS DUSKY WING				G5T2T3	SH
EUPHYES BIMACULA	TWO-SPOTTED SKIPPER				G4	S3
FARONTA RUBRIPENNIS	PINK STREAK				G3G4	S3
GLENA PLUMOSARIA					G4	SU
GRAMMIA PLACENTIA	PLACENTIA TIGER MOTH				G4	S1S3
HESPERIA ATTALUS SLOSSONAE	DOTTED SKIPPER				G3G4T3	S2S3
HETEROCAMPA VARIA	A NOTODONTID MOTH				G3G4	S3
HYPOMECIS BUCHHOLZARIA	BUCHHOLZ'S GRAY				G3G4	S3
ITAME SP 1	A SPANWORM				G3	S3
LIBELLULA AURIPENNIS	GOLDEN-WINGED SKIMMER				G5	S1S2
LIBELLULA AXILENA	BAR-WINGED SKIMMER				G5	S2BS1B,SZN
LITHOPHANE LEMMERI	LEMMER'S PINION MOTH				G3G4	S2
LOXAGROTIS SP 2					G1Q	S1
MACROCHILO SP 1	A NOCTUID MOTH				G3	S3
MEROLONCHE DOLLI	DOLL'S MEROLONCHE				G3G4	S1S3
METARRANTHIS PILOSARIA	COASTAL SWAMP METARRANTHIS				G3G4	S1S4
METARRANTHIS SP 1	A GEOMETRID MOTH				G3	S2

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NAME	COMMON NAME	FEDERAL STATUS	STATE STATUS	REGIONAL STATUS	GRANK	SRANK
NEONYMPHA AREOLATA SEPTENTRIONALIS	A SATYR				G4T3T4	S3
NICROPHORUS AMERICANUS	AMERICAN BURYING BEETLE	LE	E		G1	SH
PONTIA PROTODICE	CHECKERED WHITE				G5	S1
PTICHODIS BISTRIGATA	SOUTHERN PTICHODIS				G3	S1S3
PYGARCTIA ABDOMINALIS	YELLOW EDGED PYGARCTIA				G3G4	SH
SEMIOTHISA EREMIATA	THREE-LINED ANGLE MOTH				G4	SU
SPARTINIPHAGA CARTERAE	CARTER'S NOCTUID MOTH				G2G3	S2
ZALE SP 1	PINE BARRENS ZALE				G3Q	S3
ZANCLOGNATHA SP 1					G3G4	S3
ZANCLOGNATHA THERALIS					G4	SH
*** Other types						
BALD EAGLE WINTERING SITE	BALD EAGLE WINTERING SITE				G?	S?
COASTAL HERON ROOKERY	COASTAL HERON ROOKERY				GU	S3
MIGRATORY SHOREBIRD CONCENTRATION SITE	MIGRATORY SHOREBIRD CONCENTRATION SITE				G?	S?
*** Vascular plants						
ALOPECURUS AEQUALIS	MARSH MEADOW FOXTAIL				G5	S2
AMARANTHUS PUMILUS	SEA-BEACH PIGWEED	LT	E		G2	SH
AMIANTHIUM MUSCITOXICUM	FLY POISON				G4G5	S2
ARETHUSA BULBOSA	DRAGON MOUTH				G4	S2
ARISTIDA BASIRAMEA VAR CURTISSII	CURTIS' THREE-AWNED GRASS				G5T5	S2
ARISTOLOCHIA SERPENTARIA	VIRGINIA SNAKEROOT				G5	S3
ARTEMISIA CAMPESTRIS SSP CAUDATA	WILD WORMWOOD				G5T5	S2
ASCLEPIAS LANCEOLATA	SMOOTH ORANGE MILKWEED				G5	S2
ASCLEPIAS RUBRA	RED MILKWEED			LP	G4G5	S2

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18 NOV 1999

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NAME	COMMON NAME	FEDERAL STATUS	STATE STATUS	REGIONAL STATUS	GRANK	SRANK
ASTER RADULA	LOW ROUGH ASTER		E		G5	S1
BUCHNERA AMERICANA	BLUE-HEARTS				G5?	SX
CACALIA ATRIPLICIFOLIA	PALE INDIAN PLANTAIN		E		G4G5	S1
CALAMOVILFA BREVIPILIS	PINE BARREN REEDGRASS			LP	G4	S4
CARDAMINE LONGII	LONG'S BITTER CRESS		E		G3Q	SH
CAREX BARRATTII	BARRATT'S SEDGE			LP	G3G4	S4
CAREX MITCHELLIANA	MITCHELL'S SEDGE				G3G4	S2
CAREX PALLESCENS	PALE SEDGE				G5	S2
CAREX WILLDENOWII	WILLDENOW'S SEDGE				G5	S2
CHRYSOPSIS FALCATA	SICKLE-LEAVED GOLDEN ASTER			LP	G3G4	S3
CIRSIUM VIRGINIANUM	VIRGINIA THISTLE		E		G3	S1
CLITORIA MARIANA	BUTTERFLY PEA		E		G5	S1
COREMA CONRADII	BROOM CROWBERRY		E	LP	G4	S1
COREOPSIS ROSEA	PINK TICKSEED			LP	G3	S2
DESMODIUM PAUCIFLORUM	FEW-FLOWERED TICK-TREFOIL		E		G5	SH
ELEOCHARIS HALOPHILA	SALT-MARSH SPIKERUSH				G4	S2
ELEOCHARIS TORTILIS	TWISTED SPIKERUSH		E		G5	S1
ERIOCAULON PARKERI	PARKER'S PIPEWORT				G3	S2
ERIOPHORUM TENELLUM	ROUGH COTTONGRASS		E		G5	S1
ERYNGIUM AQUATICUM	MARSH RATTLESNAKE MASTER				G4	S3
EUPATORIUM RESINOSUM	PINE BARREN BONESET		E	LP	G3	S2
FRAXINUS PROFUNDA	PUMPKIN ASH		E		G4	S1
FUIRENA SQUARROSA	HAIRY UMBRELLA-SEDGE				G4G5	S3
GALACTIA VOLUBILIS	DOWNY MILK-PEA		E		G5	SH
GENTIANA AUTUMNALIS	PINE BARREN GENTIAN			LP	G3	S3
GLAUX MARITIMA	SEA-BEACH MILKWORT		E		G5	SH
GNAPHALIUM HELLERI	HELLER'S EVERLASTING		E		G4G5	SH
HEDYOTIS LONGIFOLIA	LONG-LEAVED BLUET				G4G5	SX
HELONIAS BULLATA	SWAMP-PINK	LT	E	LP	G3	S3
HONCKENYA PEPLOIDES	SEA-BEACH SANDWORT				G5	S2

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HOTTONIA INFLATA	FEATHERFOIL		E		G4	S1
JEFFERSONIA DIPHYLLA	TWINLEAF		E		G5	S1
JUNCUS CAESARIENSIS	NEW JERSEY RUSH		E	LP	G2	S2
JUNCUS GREENEI	GREENE'S RUSH				G5	S2
JUNCUS TORREYI	TORREY'S RUSH				G5	S1
LIMOSELLA SUBULATA	MUDWEED		E		G4?	S1
LINUM INTERCURSUM	SANDPLAIN FLAX		E		G4	S1
LISTERA AUSTRALIS	SOUTHERN TWAYBLADE			LP	G4	S2
LOBELIA CANBYI	CANBY'S LOBELIA			LP	G4	S3
LUDWIGIA BREVIPES	CREEPING LUDWIGIA				G4G5	SX.1
LUZULA ACUMINATA	HAIRY WOODRUSH		E		G5	S1
MELANTHIUM VIRGINICUM	VIRGINIA BUNCHFLOWER		E		G5	S1
MUHLENBERGIA TORREYANA	PINE BARREN SMOKE GRASS			LP	G3	S3
MYRIOPHYLLUM TENELLUM	SLENDER WATER-MILFOIL		E		G5	S1
MYRIOPHYLLUM VERTICILLATUM	WHORLED WATER-MILFOIL		E		G5	SH
NARTHECIUM AMERICANUM	BOG ASPHODEL	C	E	LP	G2	S2
NYMPHOIDES CORDATA	FLOATING HEART			LP	G5	S3
OENOTHERA HUMIFUSA	SEA-SIDE EVENING PRIMROSE		E		G5	S1
ONOSMODIUM VIRGINIANUM	VIRGINIA FALSE-GROMMELL		E		G4	S1
PASPALUM DISSECTUM	MUDBANK PASPALUM				G4?	S2
PHORADENDRON SEROTINUM	MISTLETOE			LP	G5	S2
PLANTAGO MARITIMA	SEA-SIDE PLANTAIN				G5	S2
PLANTAGO PUSILLA	SLENDER PLANTAIN		E		G5	SH
POLYGONUM GLAUCUM	SEA-BEACH KNOTWEED		E		G1	S1
PRENANTHES AUTUMNALIS	PINE BARREN RATTLESNAKE ROOT			LP	G4G5	S2
PRUNUS ANGUSTIFOLIA	CHICKASAW PLUM		E		G5	S2
PUCCINELLIA FASCICULATA	TORREY'S MEADOW GRASS				GU	S2
PYCNANTHEMUM SETOSUM	AWNED MOUNTAIN MINT				G1?	S2
RANUNCULUS CYMBALARIA	SEA-SIDE CROWFOOT		E		G5	SH
RHODODENDRON ATLANTICUM	DWARF AZALEA		E		G4G5	S1

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NAME	COMMON NAME	FEDERAL STATUS	STATE STATUS	REGIONAL STATUS	GRANK	SRANK
RHYNCHOSPORA CEPHALANTHA	LARGE-HEADED BEAKED RUSH			LP	G5	S3
RHYNCHOSPORA CEPHALANTHA VAR MICROCEPHALA	SMALL-HEADED BEAKED RUSH		E		G5T5	S1
RHYNCHOSPORA GLOBULARIS	GRASS-LIKE BEAKED RUSH		E		G5	S1
RHYNCHOSPORA INUNDATA	HORNED BEAKED RUSH			LP	G3G4	S2
RHYNCHOSPORA KNIESKERNII	KNIESKERN'S BEAKED RUSH	LT	E	LP	G1	S1
RHYNCHOSPORA NITENS	SHORT-BEAKED BALDRUSH				G4	S2
RHYNCHOSPORA PALLIDA	PALE BEAK RUSH				G3	S3
RUBUS RECURVICAULIS	BLANCHARD'S DEWBERRY				G4?	S1
RUMEX HASTATULUS	HEART-WINGED SORRELL				G5	SX.1
SABATIA CAMPANULATA	SLENDER MARSH PINK				G5	S3
SABATIA DODECANDRA	LARGE MARSH PINK				G5?	S2
SCHIZAEA PUSILLA	CURLY GRASS FERN			LP	G3	S3
SCHWALBEA AMERICANA	CHAFFSEED	LE	E	LP	G2	S1
SCIRPUS LONGII	LONG'S BULRUSH		E	LP	G2	S2
SCIRPUS MARITIMUS	SALT MARSH BULRUSH		E		G5	SH
SCLERIA MINOR	SLENDER NUT RUSH			LP	G4	S4
SOLIDAGO STRICTA	WAND-LIKE GOLDENROD			LP	G5	S3
SOLIDAGO TARDA	LATE GOLDENROD				G4?Q	S3
SPIRANTHES LACINIATA	LACE-LIP LADIES'-TRESSES		E		G4G5	S1
SPIRANTHES ODORATA	FRAGRANT LADIES'-TRESSES				G5	S2
STYLISMA PICKERINGII VAR PICKERINGII	PICKERING'S MORNING-GLORY		E	LP	G4T2T3	S1
TIPULARIA DISCOLOR	CRANEFLY ORCHID				G4G5	S3
TRIDENS FLAVUS VAR CHAPMANII	CHAPMAN'S REDTOP		E		G5T?	SH
TRIGLOCHIN MARITIMUM	SEA-SIDE ARROW-GRASS		E		G5	S1
UTRICULARIA BIFLORA	TWO-FLOWERED BLADDERWORT		E		G5	S1
UTRICULARIA MINOR	LESSER BLADDERWORT		E		G5	S1
UTRICULARIA PURPUREA	PURPLE BLADDERWORT			LP	G5	S3
UVULARIA PUBERULA VAR NITIDA	PINE BARREN BELLWORT		E		G5T3?	S2

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VERBENA SIMPLEX	NARROW-LEAVED VERVAIN		E		G5	S1
XYRIS FIMBRIATA	FRINGED YELLOW-EYED GRASS		E		G5	S1
ZIGADENUS LEIMANTHOIDES	OCEANORUS		E		G4Q	S1

192 Records Processed

Mark Southerland
Versar, Inc.
July 19, 2000

Barnegat Bay Restoration Site Testing Project – Coordination Meeting at NJDEP, Trenton

Participants:

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Introduction

On July 13, 2000, the study team for the Barnegat Bay Restoration Site Testing Project held a coordination meeting at the New Jersey Department of Environmental Protection (NJDEP) offices in Trenton. This project is a follow up to the Barnegat Bay Ecosystem Restoration Site Selection Project that was completed in March. It is an integral component of the feasibility study being undertaken by the Corps pursuant to the 1995 Congressional resolution to identify possible improvements in ecosystem restoration and protection.

The purpose of the meeting was to have preliminary discussions on the suitability of the 27 high priority restoration sites identified in the Site Selection Report for further consideration in the Corps planning process. Currently, the Corps real estate office is identifying property owners for each site. While discussions with the meeting participants had already been conducted over the phone or in person with individual members of the study team, this meeting was the first opportunity for a general discussion among key interested parties. A second meeting including more parties will be held July 20 in Toms River.

Meeting Minutes

Terry Fowler, Corps Study Manager, convened the meeting and described the background of the project. She stated that a critical factor in considering projects to take forward is the fact that a non-Federal sponsor must commit to contribute 25 to 35% of the project cost. She noted that USFWS support would not count as the match, but that activities they would be willing to do (such as phragmites control) would reduce the total cost of the project.

The attendees from NJDEP indicated that they had already developed comments based on the information package they received, so it was decided to start with general comments. Discussion

of individual sites and presentation of field investigation results from Versar would be presented as desired.

Dave Jenkins commented that historically mainland sites (e.g., the Westecunk Creek sites) have not been used for bird nesting; virtually all long-legged wading bird nesting has been on islands (presumably because of predation). Therefore, he viewed the addition of shrubby habitat for bird nesting on mainland sites as experimental. There is evidence that diamondback terrapins could use artificial habitats in these areas, but predation control would be a prerequisite for terrapins as well.

Carlo Popolizio raised the issue of retaining phragmites on islands where it is needed for erosion control. He noted that there is generally a ring of phragmites around each island between the marsh and upland areas. Larry Torok cited research (from the Meadowlands and Higby Beach) that concluded that phragmites might be as good as forest for migratory songbirds. Jenkins opined that phragmites control be done on a case-by-case basis and that the transition in vegetation should be gradual in areas such as dikes.

Helen Owens stated that there is a need for restoration of islands to coexist with continuing disposal of dredged material. Bill Dixon stated restoration projects involving disposal or requiring dredged material would necessarily have NJDEP Engineering & Construction as the non-Federal sponsor. He also noted that almost all disposal islands in south Barnegat Bay are privately owned (and used for dredged material disposal by yacht clubs), but they are usually willing to work together for habitat improvement. More importantly, NJDEP must have disposal sites available for channel maintenance dredging by the Corps; many of these are on USFWS refuge lands. Therefore, it is important that NJDEP Engineering & Construction, USACE Operations, and USFWS Refuges work out an overall plan for continuing availability of disposal sites (including sites outside the study area). Fowler suggested that these groups meet separately to develop this plan and set the context for possible restoration projects on past, present, or future disposal sites. Fowler also felt that the Corps would consider restoration on an area that would later be used for disposal.

Dixon stated that there is no problem with restoring the northern Westecunk Creek sites (TWS 15, 16, and 17), because they are too linear for disposal and the southern sites (TWS 23, 24, and 25) are preferable for disposal. Of the southern sites, he would prefer the biggest remain a disposal site. He also commented that there is generally a low availability of sandy material along the mainland for use in restoration.

Jenkins said that he would contact Ray Porutski (609-259-7995), NJDEP Fish and Wildlife Central Region Superintendent, about the Stafford Forge site (NWS02). Torok stated that rare species surveys should be conducted at this and other sites, citing the presence of barred owl (associated with cedar forest) and pine barrens treefrog (associated with remaining bogs) at Stafford Forge. He pointed out that the natural heritage data couldn't be considered comprehensive on this point. He stressed that any impacts on these species would entail a lengthy permit process. Steve Harriott stated that all the projects are designed to avoid impacts to rare, threatened, and endangered species. Owen suggested we contact Ginger Copcash about

her experience with mitigation design and success related to rare plants.

Popolizio expressed his concern over the concept of restoring historic Atlantic cedar wetlands at Cedar Run (NWS01). While this approach is included in the USFWS management plan, he felt that natural recovery of some of the abandoned cranberry bogs had created habitat of importance that would be lost in the restoration. Jenkins suggested we contact the NJDEP Parks and Forestry group considering cedar forest restoration (Wayne Cootros and Dave Edelman). Dixon noted that NJDEP Parks might have a different perspective on restoration since they manage largely for human use. He stated that Ballanger Creek (TWS02) is another abandoned cranberry bog where restoration would entail trading one type of habitat for another.

Jenkins state that the Barnegat Light site (TWS39) was one of the most important for him, because it once served as a significant tern and plover nesting site when first used as a disposal site for dredged material. It has since degraded substantially as vegetation has returned and the backwater lagoon was filled. Jenkins felt that there are three critical elements needed for successful restoration: (1) creation of a new backwater area with a connection to the tide that would provide critical feeding habitat, (2) replacement of vegetation with sandy/shelly nesting substrate, and (3) addition of storm protection (to compensate for removing dune vegetation) by extending dunes directly in front of houses. The design of these elements would be integrated with the planned inlet creation and hardening of the seawall by the Corps. While only a 2-3 acre pond is now planned for the 30-acre site, a longer pond would be preferable. By creating the pond farther from the dune and housing, the concern for child safety would be alleviated; the connection to the tide would eliminate concerns about stagnant water.

Harriott described the field investigation results obtained at the abandoned lagoon sites. The "F channel" lagoon (LAN05) has relatively high salinity, DO, and juvenile fish abundance (10-12 species). Harriott described a restoration concept that would cut a channel across the top of the lagoons, creating an island (with less predation pressure) and greater flow. Several attendees thought this was a good approach. Owen stated that the cut through should avoid the existing wetland.

Harriott described restoration concepts for the West Mantoloking (LAN06) and Bayville/Ocean Gate (LAC02) lagoons that include creating tidal connections. Both have low DO and no fish populations. The group suggested that the road be left intact at LAC02 to retain access for recreational users; a culvert could be added to make the tidal connection. Jenkins and Dixon noted that the Ocean County Mosquito Control Commission might also have an interest in reestablishing tidal flow at LAC02. They pointed out that the Commission is a potential non-Federal sponsor with the funds and equipment to support the restoration projects.

Jenkins and Dixon noted that creating sandy areas in the lagoons is problematic, because they would need a regular sand source. Any control plan should not rely on continuing pesticide application. Fowler suggested that we could design a restoration project that benefits different species as the site undergoes succession. For example, a project could create open terrapin habitat and then, as vegetation comes in, provide habitat for other species.

John Brady asked how predation problems could be addressed on islands. Jenkins said the most effective means—using private or government trappers—create a public outcry. He confirmed that virtually all the islands have a fox den.

Dixon stated that both NJDEP and the Corps need island "26" (ISS08) for disposal. Therefore frequent additions of sand can be counted on to vegetation down. The problem that needs to be addressed here is the erosion from sand placement that is affecting adjacent SAV beds. Dixon suggested using coconut erosion control mats along the SAV beds.

Jenkins pointed out that gull predation is keeping terns off otherwise suitable habitat. Where they have become well established, gulls will tolerate poorer habitat, making vegetation control efforts ineffective. The steps needed to eliminate gulls are as follows: (1) cover all vegetation on the island (moving disposal material around as needed), (2) harass gulls with pyrotechnics and other methods, and (3) set out decoys to attract the terns.

Jenkins also raised the idea of using controlled grazing to control vegetation on islands with well-established gull populations. Specifically, pigs (with a caretaker to water and protect the pigs) could be effective. Grazing would be more acceptable than other forms of nuisance species control. Sheep grazing is being used to maintain bog turtle habitat.

The group agreed that the meeting had been useful and recommended that the following other organizations be enticed to attend the July 20 meeting: USFWS refuges, NMFS, and Ocean County Mosquito Control Commission.

Mark Southerland
Versar, Inc.
July 25, 2000

Barnegat Bay Restoration Site Testing Project – Second Coordination Meeting at NJDEP, Toms River

Participants:

Terry Fowler	Corps, Coastal Planning	215-656-6575	theresa.a.fowler@usace.army.mil
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Mark Southerland	Versar	410-740-6074	southerlandmar@versar.com
Steve Harriott	Versar	410-740-6099	harriottste@versar.com
Bill Dixon	NJDEP-Eng. & Construction	732-255-0890	wdixon@dep.state.nj.us
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Suzanne Dietrick	NJDEP-Dredging	609-292-9203	sdietrick@dep.state.nj.us
Dave Jenkins	NJDEP-Fish and Wildlife	609-984-1581	djenkins@dep.state.nj.us
Roger Wood	The Wetlands Institute	609-368-1211	roger@wetlandsinstitute.org
Eric Schrading	USFWS	609-646-9310	eric_schrading@fws.gov
John Ronafalvy	PSEG	856-339-7920	john.ronafalvy@pseg.com
Carlo Popolizio	USFWS	609-383-3938	carlo.popolizio@fws.gov
Melissa Neuman	Rutgers University	609-296-5260	neuman@imcs.rutgers.edu
Paul Bologna	Rutgers University	609-296-5260	bologna@imcs.rutgers.edu
Margot Schwamb	NJDEP	609-777-0580	mschwamb@dep.state.nj.us
Don Wilkinson	NJ Fish & Wildlife	856-785-0455	

Introduction

On July 20, 2000, the study team for the Barnegat Bay Restoration Site Testing Project held a second coordination meeting at the New Jersey Department of Environmental Protection (NJDEP) offices in Toms River. This project is a follow up to the Barnegat Bay Ecosystem Restoration Site Selection Project that was completed in March. It is an integral component of the feasibility study being undertaken by the Corps pursuant to the 1995 Congressional resolution to identify possible improvements in ecosystem restoration and protection. An initial coordination meeting was held July 13 in Trenton.

The purpose of the meeting was to have constructive discussions on the suitability of the 24 high priority restoration sites identified in the Site Selection Report for further consideration in the Corps planning process. Recently, the Corps real estate office has identified property owners for each site. While discussions with several of the meeting participants had already been conducted over the phone, in the field, or during the initial coordination meeting, this meeting was the largest gathering of key interested parties. The following minutes summarize the discussion at the meeting. Key conclusions and action items are in **boldface**.

Meeting Minutes

Terry Fowler, Corps Study Manager, convened the meeting and described the background of the project. She stated that a critical factor in considering projects to take forward is the fact that a non-Federal sponsor must commit to contribute 25 to 35% of the project cost. She noted that USFWS support would not count as the match, but that activities they would be willing to do (such as phragmites control) would reduce the total cost of the project. Bill Dixon said that there would likely be a number of different sponsors given the range of restoration project types under consideration.

Mark Southerland circulated a brief agenda (see attached) and suggested that the discussion start with general comments and then proceed to discussion of individual sites (see table on back of agenda). He pointed out that the site selection process was described in the current draft Corps report and that additional site information from more intensive field investigations would be presented by Steve Harriott during the site-specific discussions. Both annotated topographic maps and individual field data sheets were available. Paul Bologna requested a copy of the site selection report; Fowler said she would send him the tables and text as they are approved.

Dixon stated that a primary concern of his office was that some sites under consideration would continue to be needed for dredged material disposal. Some sites would likely never be needed and in other cases the disposal needs and restoration needs could both be accommodated (in some cases working together). Specifically, he noted that island #26A (ISS08) would be used this year and that there is a laundry list of other sites currently seeking funding--Mill Creek, Westecunk Creek, Parkers Run, Double Creek, High Bar Harbor, Loveladies, and others. **The group agreed that a meeting with the NJDEP Office of Dredging, USACE Operations, and USFWS Refuges (owners of many of the disposal sites) needed to be convened to determine the overall plan for disposal and availability of sites for restoration by the Corps.**

At the same time, Dixon stated that the upstream Westecunk Creek sites (TWS15, 17, 18) would not be needed for disposal. Harriott stated that the restoration concept for these sites was to remove previously disposed of coarse to medium sand now forming large linear mounds. Dixon said that there would be a market for both sandy and loamy material to close a nearby landfill (given proper grain size and cleanup levels). Sandy material is unusual along the mainland. David Risilia asked if it would be possible to remove dredged material from some disposal sites to build capacity. Fowler said that a rotating use of sites was being considered. Jenkins said it was unlikely the refuge would be concerned about impacts to terrestrial vegetation. **Southerland stated that the restoration concept at Westecunk was to return the system to its natural wetland state rather than create habitats for specific species.** The Trust for Public Land has identified high values for preservation and acquisition in the area. Other sites with modified conditions or competing uses will be considered for specific habitat restoration.

Melissa Neuman asked about the restoration concept for islands in general. Dave Jenkins stated that plans including continual herbicide control would not be considered. One option is to lay down a 6-12 inch layer of crushed shell after initial control with herbicides. Carlo Popolizio

asked if we were considering leaving a ring of phragmites around islands for erosion control. The group agreed that leaving any phragmites (even live rhizomes) would ensure their recovery on the island. John Ronafalvy stated that live rhizomes could expand 30-40 feet per year. **Phragmites eradication involves (1) initially killing via herbicides (for up to 4 years if rhizomes are deep) and (2) controlling reinfestation (one option is to consolidate remnant dikes into higher islands and then plant them with trees and shrubs). He also recommended cutting channels to introduce tidal influence.** Jenkins noted that a ring of phragmites would also keep beach nesters away because their line of sight for predators would be interrupted. Dixon stated that Flat Island and High Island are both privately owned. If the Corps dredges the intercoastal waterway both will be needed as well as Cedar Island. If Mill Creek is dredged, it will use Flat Island for disposal. Dixon said that it is reasonable to include in the disposal agreement for these islands a plan to "cell off" with dikes to contain dredged material in phragmites areas.

Ronafalvy said that PSEG generally used helicopters to spray phragmites because of the narrow areas that needed targeting. Even tighter areas required 16-foot Johnboats rigged for bank spraying (although coverage was less satisfactory). Schrading said USFWS uses fixed-wing aircraft whenever possible because of cost of $10-11 per acre vs. $30-40 per acre for helicopter (which also caused eddies in dispersal and therefore required more overlap in spraying). Ronafalvy stated that ground spraying cost $800-1000 per acre and entails greater impacts from equipment.

Jenkins said that former confined disposal areas are best suited for long-legged wading bird nesting. Most common terns and skimmers nest on eelgrass mats; therefore duplicating this habitat on disposal islands would mean filling wetlands. Eric Schrading also recommends restoring for woody vegetation. Jenkins said that historically terns have used sandy areas after disposal for a couple of years only. Woody vegetation has benefits for a longer period of time and also supports migratory songbirds. Other than terns, terrapins are the only other users of sandy areas. Lastly, Jenkins noted that these species need good feeding habitat within 5-6 miles (especially shallow meandering tidal creeks) for successful nesting. In the Barnegat region, there are many areas with only open water available and that may not be adequate for these species. **Schrading concluded that (1) if there is continual disposal activity the site could be restored for beach nesters and (2) if not then the site could be restored for woody vegetation.** Jenkins added that some sites could be "cycled" with sandy habitat following disposal for a couple of years, then woody habitat enhancement to shade out phragmites, and then at some interval a return to sandy with more disposal. Dixon said that only island #26A would receive material on a continuing basis; the other sites would be used for disposal every 10-20 years.

Don Wilkinson stated that the NRCS office at Cape May courthouse is an excellent source of information on which plant species to design for. They also have the plants to use for a fee. Schrading described the USFWS coastal restoration program that has a budget for state and private (as differentiated from refuge programs) restoration. It has been controlling phragmites over thousands of acres in McNamara Wildlife Management Area. **The USFWS can provide technical and financial support (e.g., bayberry planting) to the Corps Barnegat projects.** Schrading stated that USFWS would be open to any project that's feasible regardless of its

priority. He mentioned Ducks Unlimited as a possible non-Federal sponsor and Fowler said that the landlocked Bayville lagoon (LAC02) might be a good candidate for them.

Harriott described each of the lagoon sites, noting that there were abundant juvenile fish in most. In each lagoon, there was a shallow shelf with a deep channel 15 feet or greater in the middle with anoxic muck. Dixon and Schrading suggested filling the anoxic channel to a shallower depth; Susan Dietrick said that depth testing as done for the dredge holes should determine the final depth. Ronafalvy said that if you killed the phragmites the banks would slump, providing a more gradual slope and better fish habitat. **Harriott and Schrading said that the material on the bank could be used fill the anoxic channel, thus creating a continuum from upland to beach to emergent to aquatic habitat.** The group agreed that excavation techniques were available to minimize impacts on the shallow water habitat and that any impacts would only be temporary.

Harriott described the concept of reintroducing or increasing the tidal flow into the lagoons by cutting new channels. Dixon said that increasing tidal flow would be consistent with Ocean County Mosquito Control Commission objectives and would fall under existing permits. Paul Bologna raised a concern about introducing tidal flow to the Bayville lagoon (LAN02) that is landlocked and low salinity (12 ppt vs. 23 ppt in adjacent estuary). He felt that the relatively fresh open water habitat would have a value for SAV and waterfowl. **Dixon concurred that the prudent approach would be not to add a tidal connection to Bayville, but to fill the anoxic channel if it can be determined whether the filling would affect the apparent inflow of fresh groundwater.** Wilkinson would see if there were any data on waterfowl use of this lagoon.

Harriott described the restoration concept of creating a new channel with meanders to eliminate phragmites, restore tidal marsh, and improve wildlife habitats at the Oyster Creek site (TWC21). Wilkinson asked that we determine if the ponds on the site are freshwater. Dixon stated that the nearby nuclear plant would have a need to dredge and disposal of material when the reactor is barged out. NJDEP has other disposal needs in the area as well. He suggested that the Corps project could be combined with other NJDEP needs in negotiations with the new plant owner. Wilkinson suggested creating sandy habitat for terrapins, but Dixon noted that it wouldn't remain sandy in this area. Several of the group questioned whether the tidal range in this area (less than 1 foot) would be enough to inundate and eliminate the phragmites. **Ronafalvy suggested using a RM2 or other model to determine what channels are needed.** He stated that once they are started channels naturally become sinuous, especially during storm conditions.

Bologna asked what we planned to do at the SAV sites. He noted that suitability depends on several factors, including the ability of the site to trap sediment. **Harriott said that we had not done any specific testing at SAV sites, except to evaluate their proximity to navigation courses, and that our proposal would likely be in the form of starting with a pilot project of small plantings to test the feasibility of completing the restoration.** Dixon described the situation with an ATT cable near Manahawkin/Tuckerton that impacted eelgrass. Schrading said he would get us information on this case on what ATT did to avoid and mitigate impacts.

Harriott started the discussion of restoration at the abandoned cranberry bog sites by describing

the concept at Cedar Run (NWS01). In each case, the initial idea was to return the hydrology to natural conditions by removing water control structures, so that Atlantic white cedar could return. Popolizio expressed concern that mature cedar trees at the edge of Cedar Run ponds would be lost as new cedar returned near the new stream channel. He also worried about the loss of SAV in the shallow water and suggested that we consider restoration at sites with younger bogs that have not yet seen development of vegetation with ecological value (e.g., as winter waterfowl habitat). Southerland mentioned that the USFWS Refuge Management Plan currently includes the restoration of Atlantic white cedar at Cedar Run. Popolizio said that the plan in entering public review and changes might be made. **Jenkins suggested that we contact the state parks and forestry group targeting cedar restoration (Wayne Cootras) for restoration strategies and priority locations**; Denny Fox of the Bass River preserve should also have information on this. Jenkins noted that he believed Cootras had generally targeted cedar restoration sites in fully breached bogs to the west of Garden State Parkway (i.e., outside of the study area).

Popolizio also had reservations about changes considered for Ballanger Creek (TWS02), noting that the upper cell has a mix of vegetation, including state rare species, while the lower cell is more open. He would focus on controlling phragmites in the lower cell and increasing threesquare and other desirable plants. John Brady asked if there was evidence of cedar contraction following draining of cranberry bogs. Harriott noted that both sites would need refurbishing of existing dikes or continued presence of beavers, if the ponded habitat was to be retained. **Jenkins suggested checking with the natural heritage program for which species are present on these sites.** Southerland noted that Larry Torok in the previous meeting said that there might be species occurrences not recorded by heritage and each site should be surveyed.

Wilkinson stated that NJ was already investing $400K to replace dikes and do other work at Stafford Forge (NWS02) to preserve it as a unique waterfowl habitat. **Therefore, he needs to retain the open water, but would be amenable to restoring cedar along the fringes and providing anadromous fish passage.** He also noted that restoration of cedar entails electric fencing to exclude white-tailed deer. Popolizio would also like to preserve the mudflats in the southeast of the site; he asked whether the two large ponds without vegetation could be drained. Wilkinson said these ponds were part of the site plan and had yet to develop better habitat, because lack of funds had prevented putting in the water control structures needed to selectively draw down and build vegetation.

Bologna cautioned that any anadromous fish passage restoration needs should include substantial stocking for 5-6 years, because return to the streams is scent dependent. Ronafalvy said that PSEG has built 8 fish ladders and have runs of up to 1000 adult herring and 15-16K juveniles after 4 years. He noted that the hydrodynamic velocity is critical (Delaware species like lower velocities than fish in Northeast). Eel passage is easily achieved with astroturf or tacky material on simple platforms or in PCV pipe (per Wilkinson).

Southerland asked Ronafalvy what pH threshold he used for identifying potential fish runs in the Delaware. Ronafalvy said he chose pH of 7, because he needed to guarantee success in the short run. **Schrading contrasted this with the USFWS policy in NJ where fish passage is pursued wherever there has been a historic fish run and the land use has not been greatly altered**

(even where there is low pH and questionable zooplankton abundance). He said they were not monitoring, because it was irrelevant given the goal of returning these streams to their natural condition. Batso Run and May Run have existing fish runs and are low pH. Southerland asked if Double Trouble would be an option for fish passage given this rationale, even with a pH of 3.9. He noted Zich listed it as having a historical run and Byrne identified it as a restoration candidate. Fowler said that it might be considered as a simple project to return natural hydrology without the need to study the condition of fish habitat.

The last site discussed was Barnegat Lighthouse. Dixon opined that the lagoons and Barnegat Lighthouse are the best restoration opportunities; he felt that the marsh and island disposal sites are more speculative. Reiterating the discussion held in the previous meeting, Jenkins described the history of the site as a disposal site that attracted the regions greatest abundance of beach nesting birds, only to see them leave as vegetation grew and other conditions changed. He described his concept of (1) eliminating vegetation and placing crushed shell as nesting habitat and (2) creating a linear shallow water area connected to the ocean that would provide feeding habitat. He would address concerns over removing dune vegetation by extending the dune to the north of the site closer to the residences. **Brady suggested a site visit that would include Corps staff involved in the new construction planned for shoreline stabilization at the site.**

State of New Jersey

Christine Todd Whitman
Governor

Department of Environmental Protection

Robert C. Shinn, Jr.
Commissioner

Land Use Regulation Program
501 East State Street
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September 18, 2000

Steve Harriott
Versar Inc.
9200 Rumsey Road
Columbia, Maryland 21045-1934

RE: USACE, Philadelphia District
Barnegat Bay Ecosystem Site Selection Report
Feasibility Study of 27 Potential Ecological Restoration Sites

Dear Mr. Harriott:

This is in response to your request for comments dated May 26, 2000, and to follow up on our July 13, 2000 meeting regarding 27 projects which are part of a USACE, Philadelphia District, "feasibility study to identify possible improvements in ecosystem restoration and protection in Barnegat Bay, New Jersey". The Land Use Regulation Program is providing the following general comments regarding the projects.

1. Our most important comment is that much more detailed information is required regarding the proposed projects for the Land Use Regulation Program to determine if the projects are consistent with our Coastal Zone Management Program and Freshwater Wetlands Protection Act. Additional information must be gathered at each site regarding the existing biological communities, and the extent of the wetlands and surrounding communities that will be altered by the projects. You should clearly define the goal of each restoration plan, and demonstrate that the resultant ecosystems and habitats must be evaluated and compared to that of the existing ecosystems and habitats. Based on those evaluations a finding must be made that the project will result in an ecosystem with greater ecological value than currently exists.

2. Before proceeding further with plans for any sites where an existing wetland community will be altered, please contact Ginger Kopkash, who is Land Use Regulation Program's representative on the Wetlands Mitigation Council. Ms. Kopkash may be reached at (609) 633-6563. She has extensive knowledge of wetland communities and mitigation efforts throughout the State, and has offered to provide technical guidance for the projects. She can offer guidance regarding the requirements for your biological assessments, help you assess the ecological value of the projects, and provide technical assistance regarding construction and habitat success.

Permitting Requirements

3. Most of the proposed projects entail work in a freshwater wetland or wetland buffer, or entail work that will alter the hydrology and vegetation of the freshwater wetlands. Be advised that these activities are regulated pursuant to the Freshwater Wetlands Protection Act (N.J.S.A.

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13:19-1 et seq.) and the ACOE is required to obtain a Freshwater Wetlands permits for these activities, unless the activity is exempt from State permitting requirements pursuant to Section 404 (r) of the Clean Water Act. Section 404 (r) exempts the discharge of dredged or fill material as part of the construction of a Federal project specifically authorized by Congress, if information on the effects of such discharge, including consideration of the guidelines developed under section 404 (b) (1) is included in an environmental impact statement for such project pursuant to the National Environmental Policy Act of 1969, is submitted to Congress before the actual discharge of dredged or fill material in connection with the construction of the project, and prior to either authorization of such project or an appropriation of funds for each construction.

For projects which are not exempt from State permitting requirements there is a General Permit for fish and wildlife management activities on publicly owned or controlled wildlife management areas, parks or reserves that certain projects may qualify for. Please see N.J.A.C. 7:7A-9.2(b)16 for the permit standards. Restoring the West Creek and Cedar Creek to their natural channels and removal of water control structures will require a Freshwater Wetlands Individual Permit. Once the projects have been researched fully, and the likelihood of success and improved function and value established, I suggest that we meet again in the future to discuss the specific requirements for and Individual Permit application.

The Program has recently proposed an amendment to the General Permit no. 16 that will allow habitat creation and enhancement activities in freshwater wetlands, transition areas, and State open waters, necessary to implement a plan for the restoration, creation or enhancement of the habitat and water quality functions and values of wetlands, which is sponsored or partially funded by a Federal or State agency or other resource protection agency. Your projects may qualify for the amended General Permit, when adopted, rather than the Individual Permit. For your information I have attached a copy of the proposed amendment. Since the Freshwater Wetlands permitting requirements may change over the next year or so, I recommend that you call me periodically to discuss the permitting requirements in more detail.

4. It appears that the projects to remove water control structures and to restore West Creek and Cedar Creek to their natural channels are regulated under the Flood Hazard Area Control Act N.J.S.A. 58:10, and you may be required to obtain a Stream Encroachment Permit from our office to conduct these activities. I recommend that you contact Vince Mazzei of our office at (609) 292-8262 for further information regarding the Stream Encroachment regulations and permitting requirements that apply to these projects.

5. Any work to occur in a mapped coastal wetland, below the mean high water line, or on a beach or dune will require a Federal Consistency Determination with New Jersey's Coastal Zone Management Program.

Westcunk Creek sites TW S15, TWS17, TWS18, TWS23, TWS24, TWS25
Project: Removal of phragmites and fill. Creation of open sandy areas for nesting birds and diamondback terrapins.

6. Before proceeding further with restoration plans regarding these sites, biological inventories of these sites must be performed to determine if any rare, threatened or endangered plant or animal species exist on these sites which would be affected by the proposed projects. It is recommended that you contact Bob Cartica of NJ Natural Lands Management for information

regarding rare, threatened or endangered plants and the Natural Heritage Program (NHP) for information regarding rare, threatened or endangered animal species at your sites. Mr. Cartica may be reached at (609) 984-1015, and NHP may be reached at (609) 984-0097.

7. Before proceeding further with plans regarding sites in Brigantine NWR, contact the U.S. Fish and Wildlife Service (FWS) to determine if these projects are consistent with FWS's plans to manage the federally owned sites.

8. Additional information is required regarding the value of the existing phragmites habitats at these sites and at the other proposed project sites. As Larry Torok or NJDEP Land Use Regulation Program commented at our July 13, 2000 meeting, phragmites areas do have positive ecological value, and habitat substitution may not result in increased biological value. Phragmites stands are used by American Bitterns, and night herons. They provide a visual barrier between wildlife and man. A phragmites stand in the middle of a salt marsh may provide hiding places for certain species from predators, and a resting place for migrating birds. The rhizomes also provide excellent water quality by stabilizing soils and by the uptake of nutrients.

9. You must evaluate the sites to determine if removal of fill will alter hydrology of existing freshwater wetlands located "behind" sites 24, 25, & 26.

10. At the July 13, 2000 meeting Dave Jenkins, of NJDEP Division of Fish and Wildlife, indicated that beach nesting birds are not likely to use these creek side sites. Perhaps the projects can be altered to create smaller, sandy areas, for diamondback terrapins and enhance other portions of the sites for colonial nesting birds or other species.

11. At the July 13, 2000 meeting Bill Dixon, of NJDEP Bureau of Coastal Engineering, indicated that large sites located closest to the creek mouth are the most valuable for future for dredged material disposal associated with navigation channel maintenance. A management plan to allow continued use as dredged material disposal and habitat enhancement must be formulated in cooperation with the property owners, ACOE Operations and Maintenance Branch, NJDEP Bureau of Coastal Engineering, NJDEP Office of Dredging and Sediment Technology, U.S. Fish and Wildlife Service, and NJDEP Division of Fish and Wildlife before proceeding further with restoration plans regarding these sites.

12. Also, see comments 1, 2, 3, 5, 13, and 15.

Stafford Forge WMA sites NWS02, NWS03, Cedar Run site NWS01, Ballanger Creek TWS02
Project: Removal of water control structures to restore anadromous fish passage and recolonize Atlantic White Cedar wetlands. Restore West Creek and Cedar Creek to their natural channels.

13. Before proceeding further with plans regarding these sites, contact Tony Petrongolo of NJ Division of Fish and Wildlife, Bureau of Development and Maintenance, to determine if these projects are consistent with NJDEP plans to manage State owned sites. Mr. Petrongolo may be reached at (609) 984-1401.

14. Before proceeding further with plans regarding these sites, contact the Pinelands Commission at (609) 894-9342 to determine if these projects are consistent with the Pinelands Comprehensive Management Plan and environmental regulations.

15. These sites are likely habitat for pine barren tree frog and barred owl. Please contact Natural Heritage Program and Larry Torok for information regarding the occurrence of threatened or endangered species habitat in the project areas. Mr. Torok may be reached at (609) 633-6563.

16. Additional information is required for the Land Use Regulation Program to assess the proposed project's biological value, impacts, and potential for success. Additional information must be gathered at each site regarding the existing biological communities, and the extent of the wetlands and surrounding communities that will be altered by the projects. A comparison of the existing and proposed habitats must be evaluated, and the evaluation must clearly demonstrate that the proposed projects will result in ecosystems with greater ecological value than currently exists. Further investigations are required to determine if the plan to restore historic Atlantic White Cedar Wetlands requires modifications to the soils and intensive planting efforts, as Atlantic White Cedar is not likely to recolonize on it's own seed source. Also, deer control measures must be incorporated into the plans to prevent foraging of the newly planted seedlings.

17. Also see comments 1, 2, 3, 4, and 23.

Barnegat Light site TWS39
Project: Phragmites, beach grass, and herbaceous vegetation removal and sand fill to create beach-nesting bird habitat.

18. The Land Use Regulation Program strongly recommends elimination of the proposed project from the study. At July 13, 2000 meeting Dave Jenkins indicated that beach nesting birds are not likely to nest in the project area, as they did not prior to phragmites growth. There is currently a tidally flowed wetlands on the beach that is hydrologically connected to Barnegat Inlet by a tidal creek. This tidal wetland complex is contiguous with the phragmites dominated freshwater wetland on the Barnegat Light Beach. The removal of wetlands vegetation and filling with sandy material to create nesting bird habitat is prohibited under our CZM rules as there are alternatives to enhance habitat that would not result in the destruction of freshwater wetlands.

Be advised that the Program has engaged in numerous discussions with Dave Jenkins and Barbara Conklin, of the ACOE, regarding enhancements to the beach nesting bird habitat in the vicinity of the seaward end of the inlet south jetty. The ACOE recently received a Federal Consistency Determination for the South Jetty Repair that will entail backfilling tidal pools along the south side of the jetty. To provide a tidally flowed feeding area for beach nesting birds the ACOE designed the project to allow the tidal pools at the seaward end of the jetty to remain, and construct a cross-dike to prevent the tidal waters from flowing westward along the jetty. A plan to create a small, shallow, tidally flowed pond in the beach near the seaward end of the jetty may be considered, however, that plan would require full approval from the Barnegat Light Borough. This proposal should be further coordinated with Dave Jenkins and the U.S. Fish and Wildlife Service. Be advised that any work on a beach or dune must carried out in accordance with the Coastal Zone Management Rules (N.J.A.C. 7:7E-1.1 et seq.), specifically, N.J.A.C. 7:7E-3A Standards For Beach And Dune Activities.

19. Also see comments 3 and 5.

Oyster Creek TWC21
Project: Improve a portion of 200 acre site by vegetation removal in upland phragmites area and removal of phragmites from a wetland area.

20. Before proceeding further with plans regarding restoration of the site contact the current owner of the Oyster Creek nuclear power plant to determine if the project is consistent with the owner's plan for this site. It may be necessary to leave a portion of the dredged material disposal site for future maintenance dredging of the Oyster Creek intake channel, which is necessary for the power plant cooling system. See comment 11 above.

21. On a 200 acre open space site a small area of phragmites wetlands may provide a valuable habitat at this site. See comments 1, 2, 3, and 8 regarding phragmites removal.

22. Also see comments 6 and 10.

Silver Lake area of West Creek NWSO3
Project: Removal of a water control structure to restore anadromous fish passage to Westecunk Creek.

23. Removal of water control structures that meet the definition of a dam under the State's Dam Safety Standards is a regulated activity and requires a permit from the NJDEP Division of Engineering and Construction. For further information contact John Ritchey of the Dam Safety Program at (609) 084-0859. This also applies to projects at Stafford Forge WMA sites NWS02 and NWS03, Cedar Run site NWS01, and Ballanger Creek site TWS02.

24. Also see comments 1, 2, 3, 4, 6, 13, 14, and 15 may apply.

West Mantoloking sites LAN05 & LAN06, Bayville Lagoon site LAC02
Project: Fill removal and marsh reestablishment, and other improvements.

25. The suggestion that "some areas of mounded materials could be pushed back into the water and then replanted for reestablishment of tidal marsh" (LAN05 & LAN06) is discouraged pursuant to N.J.A.C. 7:7E-4.2(j) Acceptability Conditions for Uses – Filling of the Rules on Coastal Zone Management. As such, it is strongly recommended that the proposed creation of tidal marsh by filling of open water areas be eliminated from the proposed projects. Creation of tidal marsh by excavation of upland areas would be acceptable, provided that the habitat created has a greater biological value and function than the existing habitat.

26. Public access to these areas must be maintained. While removal of the road to Bayville Lagoon will prevent illegal dumping, it will reduce the ability for the public to access the waterfront for fishing and to access duck blinds. Additional information is required for the Land Use Regulation Program to evaluate the impacts to the public access that will result from the removal the road and the installation of new paths and boardwalks.

27. Before proceeding further with plans regarding the abandon lagoon sites in Forsythe NWR, contact the U.S. Fish and Wildlife Service (FWS) to determine if these projects are consistent with FWS's plans to manage the federally owned sites.

28. Before proceeding further with plans regarding the Bayville Lagoon site contact the Ocean County Land Trust to determine if these projects are consistent with Ocean County's plans to manage the County owned site.

29. Also see conditions 1, 2, 3, 5, 6, and 8.

High Island ISS03. Cedar Bonnet Island ISS01, & Flat Island ISSO2
Project: Remove phragmites and other vegetation, cover with clean sand material to create beach nesting bird, colonial nesting bird, and diamondback terrapin habitat.

30. The project sites are confined disposal facilities. Northern Harriers and colonial nesting birds are known to use these sites. A plan to enhance these sites must avoid impacts to these species and their habitats, and should be further coordinated with Dave Jenkins and the U.S. Fish and Wildlife Service. Flat Island is known to contain phragmites dominated freshwater wetlands, and the other islands should be investigated for freshwater wetlands. Cedar Bonnet Island is owned by USFWS. Additional information is required regarding the method placement of new sand on these sites, material containment, and the source of the material. Source of material will determine whether a Federal Consistency Determination with CZM is required.

31. Phragmites currently stabilizes the steep dikes, and it is strongly recommended that phragmites is not removed from the dikes because it prevents sedimentation to the adjacent coastal wetlands and water area. More detailed information regarding the proposed method of phragmites removal on other portions of the site is required to determine if it will be successful.

32. Also see comments 1, 2, 3, 6, 7, 8, 11, and 15.

Island #26A ISS08
Project: Removal of phragmites and herbaceous vegetation from dredged material disposal island for beach nesting bird and diamondback terrapin habitat.

33. The proposed project appears to be a temporary enhancement project, and that the phragmites and other vegetation will recolonize the island is a short time. While more aggressive measures for phragmites removal would extend the lifetime of the project, soil stabilization of the island is important to avoid sedimentation of the nearby navigation channel. Source of material will determine whether a Federal Consistency Determination with CZM is required. An investigation of the "dip" areas should be conducted to determine if these areas are freshwater wetlands. This project should be further coordinated with Dave Jenkins and the U.S. Fish and Wildlife Service.

34. See comments 1, 2, and 3 if applicable. Also, see comments 5 and 11.

SAN02

35. This site is located in the North Region, as shown on Figure 1 of the information provided. A 1-page description sheet for this site was not included in the information provided to the Program.

I hope that this information is useful in evaluating the proposed projects in terms of the Coastal Zone Management Rules and the Freshwater Wetlands Protection Act Rules. If you have any questions regarding this letter, or would like to schedule a meeting to discuss these comments in more detail, please do not hesitate to call me at (609)292-8262.

Sincerely,

Helen A. Owens

Helen A. Owens
Project Manager, Shorefront Region
Bureau of Coastal Regulation

Attachment: FWW General Permit 16
c: Lance Miller, Division of Watershed Management
Larry Torok Land Use Regulation Program
Ginger Kopkash, Land Use Regulation Program
John Ritchey, Dam Safety Program
Dave Jenkins, Division of Fish and Wildlife
Terri Fowler, USACOE, Philadelphia District, Planning Division

Remediation Program or by the U.S. Environmental Protection Agency.

(d) Activities under general permit 14 shall comply with all applicable requirements at N.J.A.C. 7:7A-4.3, Conditions that apply to all general permits.

7:7A-5.15 General permit 15—Mosquito control activities

[15. Mosquito] (a) General permit 15 authorizes activities in freshwater wetlands, transition areas, and State open waters necessary for mosquito control water management activities conducted by a county mosquito control agency, or by a Federal agency on Federal land[, provided:].

(b) The agency shall submit an individual, site-specific project proposal to the State Office of Mosquito Control Coordination. If the State Office of Mosquito Control Coordination determines that the project is necessary to control a documented mosquito problem affecting existing residents, the agency shall submit an application to the Department for authorization to act under general permit 15.

(c) In conducting activities under general permit 15, an agency shall:

1. Comply with "Best Management Practices for Mosquito Management," issued by the State Mosquito Control Commission, and available from the Department at PO Box 400, Trenton, N.J., 08625;

[i. Best] 2. Use best management practices [are employed] including, but not limited to, shallow swales no more than three feet wide, and low sills no more than three feet wide;

[ii. Disturbance] 3. Minimize disturbance of vegetation [is minimized]; and

[iii. Only] 4. Use only light equipment [is used;].

[iv. Excavated spoils are removed or] (d) The agency shall remove excavated or dredged material. Alternatively, if the agency demonstrates that the material will not alter the character of the wetlands, the agency may spread it evenly in a shallow layer no more than three inches deep [on-site;].

[v.](e) The agency shall ensure that excessive drainage does not occur, and that the existing hydrologic condition of the hydric soils is maintained [(that is, excessive drainage is not permitted);].

(f) A county agency applying for authorization under general permit 15 shall provide public notice of the application in accordance with this subsection, and shall not be subject to the public notice requirements found at N.J.A.C. 7:7A-10.9. The county agency shall publish a display advertisement describing the proposed general permit activities. The advertisement shall be:

1. At least four column inches in size;

2. Published in a newspaper with local circulation, including the municipality; and

3. Published in a newspaper with regional circulation, including the county.

(g) The Department shall not authorize activities under general permit 15 more frequently than once every five years for a particular site.

(h) Activities under general permit 15 shall comply with all applicable requirements at N.J.A.C. 7:7A-4.3, Conditions that apply to all general permits.

[vi. The activities do not take place in exceptional resource value freshwater wetlands; and

vii. The county mosquito control agency or Federal agency submits individual, site-specific project proposals to the Administrator of the State Office of Mosquito Control Coordination, and the Administrator determines that the project is necessary to control a documented mosquito problem to existing residents. After approval by the Administrator, the project shall then be submitted to the Department for Statewide General Permit review in accordance with the requirements of this chapter.]

7:7A-5.16 General permit 16—Habitat creation and enhancement activities

[16. Fish and wildlife management activities which do not involve the discharge of more than 10 cubic yards of clean fill, carried out in publicly owned or controlled wildlife management areas, parks or reserves. These activities include, but are not limited to:

i. The placement of artificial nesting structures, nesting islands, observation blinds, sign posts, or fencing;

ii. The clearing, burning or removal of vegetation to increase habitat diversity or to control nuisance flora (when carried out in accordance with an approved wildlife management plan); and

iii. The blocking or filling of human-made drainage ditches for the purpose of restoring previously existing wetland conditions.]

(a) General permit 16 authorizes habitat creation and enhancement activities in freshwater wetlands, transition areas, and State open waters, necessary to implement a plan for the restoration, creation or enhancement of the habitat and water quality functions and values of wetlands, which is sponsored or partially funded by a Federal or State agency or other resource protection agency. For the purposes of this general permit, a "sponsor" shall be an active participant in or financial contributor to the activities, and shall approve the activities in writing.

(b) General permit 16 authorizes any of the following:

1. A fish and/or wildlife management plan created or approved by the Department's Division of Fish and Wildlife;

2. A project plan approved under the Partners for Fish and Wildlife program, administered by the U.S. Fish and Wildlife Service;

3. A project plan created by the U.S. Department of Agriculture's Natural Resources Conservation Service under the Wetlands Reserve program, the Conservation Reserve program, the Conservation Reserve Enhancement program, the wildlife habitat incentive program (WHIP), or a similar program, and approved by the local Soil Conservation District;

4. A plan approved by the Department's Office of Natural Resource Damages for the restoration, creation or enhancement of natural resources injured as the result of an oil spill or release of a hazardous substance;

5. A mitigation project required by and approved by a government agency, such as the U.S. Army Corps of Engineers;

6. A habitat creation or enhancement plan carried out by one of the Federal or State agencies at (b)1 through 5 above; or

7. A habitat creation or enhancement plan carried out by a charitable conservancy, as defined at N.J.A.C. 7:7A-15.1, provided that the plan is sponsored or approved by one of the Federal or State agencies at (b)1 through 5 above.

(c) To be eligible for authorization under general permit 16, an applicant shall demonstrate that the proposed project:

1. Is part of a comprehensive plan for the restoration, creation or enhancement of the habitat and water quality functions and values of wetlands, transition areas, and/or State open waters;

2. Is sponsored or partially funded by a Federal or State agency or other resource protection agency;

3. Is consistent with the goals of the Freshwater Wetlands Protection Act;

4. Will improve the values and functions of the ecosystem; and

5. Will have a reasonable likelihood of success.

(d) General permit 16 does not authorize an activity unless the sole purpose of the activity is habitat creation or enhancement. For example, general permit 16 does not authorize construction of a detention basin in wetlands for stormwater management, even if the detention basin or the project of which the basin is a part will also result in habitat creation or enhancement. Similarly, general permit 16 does not authorize a flood control project that may also result in creation or enhancement of some wildlife habitat.

(e) Examples of habitat creation and enhancement activities that may be authorized under general permit 16 are:

1. Altering hydrology to restore or create wetlands conditions, such as by blocking, removing, or disabling a human-made drainage ditch or other drainage structure such as a tile, culvert or pipe;

2. Breaching a structure such as a dike or berm in order to allow water into an area;

3. Placing habitat improvement structures such as:

i. Nesting islands;

ii. Fencing to contain, or to prevent intrusion by, livestock or other animals; and

iii. Fish habitat enhancement devices or fish habitat improvement structures such as placed boulders, stream deflectors, or brush piles;

4. Regrading to provide proper elevation or topography for wetlands restoration, creation, or enhancement; and

5. Cutting, burning or otherwise managing vegetation in order to increase habitat diversity or control nuisance flora.

(f) Activities under general permit 16 shall meet the following requirements:

1. The activities shall disturb the minimum amount of freshwater wetlands, transition areas, and/or State open waters necessary to successfully implement the project plan; and

2. The activities shall not decrease the total combined area of freshwater wetlands, State open waters and/or transition areas on a site. However, the Department may approve such a decrease if the Department determines that the activities causing the decrease are sufficiently environmentally beneficial to outweigh the negative environmental effects of the decrease. In addition, the Department may approve conversion of wetlands to State open waters or transition area, conversion of State open waters to wetlands or transition area, or the conversion of transition area to freshwater wetlands or State open waters, if the Department determines that such conversion is environmentally beneficial.

(g) An application for authorization under general permit 16 does not require an application fee under N.J.A.C. 7:7A-11.

(h) If a project complies with general permit 16 and also includes an activity covered under another general permit, the entire project shall be authorized through general permit 16 and shall not require authorization under the other general permit, provided that each activity covered by another general permit complies with that general permit's requirements and limits. For example, if a habitat creation project includes bank stabilization activities, and meets all requirements of general permit 20 as well as general permit 16, the Department may authorize the project under general permit 16 alone.

(i) If an activity is exempt under this chapter, it shall not require authorization under general permit 16 solely by virtue of being conducted as part of a program included in (b) above. For example, if a farmer proposes a habitat enhancement project that is eligible for authorization under general permit 16, and some of the activities involved in the project meet the requirements for the farming exemption under N.J.A.C. 7:7A-2.8(c), those activities do not lose their exempt status merely by virtue of being part of a project authorized under general permit 16.

(j) Activities under general permit 16 shall comply with all applicable requirements at N.J.A.C. 7:7A-4.3, Conditions that apply to all general permits.

7:7A-5.17 General permit 17—Trails and boardwalks

[17. Trail] (a) General permit 17 authorizes activities in freshwater wetlands, transition areas, and/or State open waters necessary for construction of a trail and/or boardwalk [construction on publicly owned or controlled park land, wildlife management areas or reserves, in freshwater wetlands or State open waters, provided:] for use by pedestrians, bicycles, and other non-motorized methods of transport. General permit 17 does not authorize construction of a restroom, gazebo, rain shelter, or any covered or enclosed structure. General permit 17 does not authorize construction of a roadway for use by automobiles, golf carts, or other motor vehicles.

(b) The total area of freshwater wetlands, transition areas, and/or State open waters disturbed under general permit 17 shall not exceed one-quarter acre.

[i.](c) The [width of the] trail or boardwalk [does not exceed] shall be no wider than six feet, [except for barrier free trails or boardwalks designed in accordance] unless the applicant demonstrates that it must be wider in order to comply with the Barrier Free Subcode of the Standard Uniform Construction Code, N.J.A.C. 5:23-7. [This general permit does not authorize construction of restrooms, gazebos, rain shelters, or any covered or enclosed structure;

ii. Natural materials such as wood chips or wooden planks are used to the maximum extent practicable;]

(d) The trail or boardwalk shall:

1. Be located and configured so as to minimize adverse environmental impact; and

2. Incorporate features designed to educate the user about the importance of freshwater wetlands, transition areas, and State open waters; for example, through signs identifying plants and animals or explaining hydrology, ecology, or other significant environmental features or phenomena.

[iii. The project does] (e) The permittee shall take all measures necessary to ensure that activities under general permit 17 do not interfere with the natural hydrology of the area[; and], such as installation at grade or use of cross drains to allow the passage of water. The permittee shall minimize the impact of the activities on vegetation.

[iv. The project does not encroach upon or adversely affect the habitat of any threatened or endangered species.]

(f) An application for authorization under general permit 17 for a project on publicly owned land does not require an application fee under N.J.A.C. 7:7A-11.

(g) Activities under general permit 17 shall comply with all applicable requirements at N.J.A.C. 7:7A-4.3, Conditions that apply to all general permits.

7:7A-5.18 General permit 18—Dam repair

[18. The repair, rehabilitation, replacement, maintenance or reconstruction as required by the Dam Safety Standards (N.J.A.C. 7:20-1), of any previously authorized, currently serviceable dam structure, as defined at N.J.A.C. 7:20-1.2, including appurtenant structures, lawfully existing prior to July 1, 1988 or permitted under the Act, provided that the previously authorized structure has not been put to uses differing from those specified in any permit authorizing its original construction. Minor deviations due to changes in materials or construction techniques and which are necessary to make repairs, rehabilitation, replacement, maintenance or reconstruction are allowed provided that:

i. The activity is conducted in accordance with a Dam Permit issued pursuant to N.J.A.C. 7:20-1;

ii. The activity results in the filling of no more than one acre of wetlands or State open waters;

iii. If located in exceptional resource value wetlands, the activity will not negatively impact the documented threatened or endangered species or its habitat;

iv. The activity is designed to minimize disturbance and other detrimental effects upon freshwater wetlands or State open waters through the use of best management practices including, but not limited to:

(1) Stabilizing all disturbed areas; and

(2) Using suitable, clean, non-toxic fill material; and

v. The activity will not increase the normal water surface elevation. The normal water surface elevation is the historic level as of the date of completed dam construction and inundation.]

(a) General permit 18 authorizes the repair, rehabilitation, replacement, maintenance, reconstruction, or removal of a dam, as defined in the Department's dam safety rules at N.J.A.C. 7:20-1.2.

(b) A dam that is currently serviceable may be repaired, rehabilitated, replaced, maintained or reconstructed under general permit 18. A dam that is not currently serviceable may not be repaired, rehabilitated, replaced, maintained or reconstructed, but may be removed. A dam is considered currently serviceable if it meets any of the following criteria:

1. The dam is in use at the time of submittal of the general permit application;

2. The dam has been out of use for no more than five years prior to submittal of the general permit application; or

3. The dam has been out of use for up to 10 years prior to submittal of the general permit application, but the applicant documents that public funding was actively sought for repairs during the ten years.

(c) Activities under general permit 18 are subject to the following limits:

Steve Harriott
Versar, Inc.
17 August 2000

Meeting on Stafford Forge site (NWS02) restoration, Southern Region Office, New Jersey Department of Environmental Protection

Participants:

Ray Porutski	Regional Superintedent/NJDEP Fish, Game & Wildlife	(609) 259-2132
Don Wilkinson	Principal Biologist/NJDEP Fish, Game & Wildlife	(856) 785-0455
Hugh Carberry	Principal Biologist/NJDEP Fish, Game & Wildlife	(856) 629-4950
Wayne Tonnesen	Conserv. Officer/NJDEP Bureau of Law Enforcement	(609) 259-2120
Ted Nichols	Biologist/NJDEP Fish, Game & Wildlife	(856) 629-4950
Steve Harriott	Professional Wetland Scientist/Versar, Inc.	(410) 740-6099

Introduction

On 16 August 2000, a meeting was held at the NJDEP Fish, Game & Wildlife Southern Region Office to discuss restoration potential at the Stafford Forge Wildlife Management Area (NWS02) under the Barnegat Bay Restoration Site Testing Project. The purpose of the meeting was to gather site-specific information from NJDEP relating to their plans for replacement of existing water control structures and to potential future uses of the site. The following minutes summarize the discussion at the meeting. Key conclusions and action items are in **boldface**.

Minutes

Steve Harriott indicated the nature and timing of the studies conducted at Stafford Forge by Versar, discussed the kinds of data that were collected, and showed aerial photos and maps where water quality and physical stream habitats were assessed (on-site and both upstream and downstream). Hugh Carberry asked whether the Zich report on area fisheries resources had been reviewed. He voiced a concern that the Zich report apparently makes no mention of a historic alewife run on Westecunk Creek; it is not known, therefore, whether such a run ever really existed. He asked about pH on the creek, and when Versar's field studies were performed. Harriott indicated that field studies were performed in late May 2000, and that the pH was generally around 5.0 (he made the raw data sheets available for all). Because of the low pH, Carberry believes that alewife (and not blueback herring) is the population we should be attempting to establish. He asked whether we were aware that the upper watershed would have to be "seeded" with fry for up to three years for successful establishment (he said at least 4 fish per acre is the quantity for lacustrine habitats, but was not sure of the appropriate quantity for riverine habitats). **Carberry indicated that it would be appropriate to collect additional pH measurements from mid-April to the end of April (when the alewife run would actually take place), and to also perform gill-netting in the creek to determine how far upstream alewife currently exist** (anecdotal information indicates that they move upstream to the NWS03/Silver Lake site). Harriott agreed, and said collection of those kinds of data would be appropriate in the feasibility phase of the project. **Wayne Tonnesen stated that it may also be appropriate to talk to local fishermen who live on Westecunk Creek about existing fisheries**

resources; all agreed.

Don Wilkinson asked Harriott about the most current conceptual plans for NWS02. Harriott described elements of the conceptual plan, including restoration of the natural creek channel through the site, restoration of Atlantic white cedar wetlands along the (restored) creek, and restoration of the anadromous fishery throughout the creek. He explained that this would involve draining both the upper (northern-most) and lower ponds. **Wilkinson asked whether anadromous runs would be contingent on implementation of the project at NWS03 (removal of small fish blockage at the Silver Lake site), because of its location downstream of NWS02. Everyone agreed that it would.** Harriott passed around ground-level photographs of the NWS03 site to show the relatively small scale of that project; specifics concerning that project were discussed. He indicated that it probably would not be a difficult or expensive project with cooperation of the private landowners, but it is never certain whether restoration can be implemented at privately-owned sites.

Ray Porutski indicated that it would be out of the question to drain the upper and lower ponds (ponds #1 and #5, respectively) at NWS02, because of NJDEPs long-term investment in the dikes, structures, and other resources at the site. He indicated a willingness to perform other aspects of restoration, such as partial draining of Ponds #2 and #3 to allow for growth of emergent wetlands plants (similar to current conditions on the northern and western ends of pond #1). Tonnesen stated that these two ponds are relatively shallow already, averaging about 5 to 6 feet deep. Ted Nichols agreed that the presence of such wetlands with abundant emergent plants (as opposed to the current open water condition) would increase waterfowl use of these ponds. He stated that current waterfowl use of the site is limited to pond #1 and pond #5, and that this existing use is somewhat limited in both the number of species and the total number of birds. Porutski also said he was willing to incorporate Atlantic white cedar wetlands restoration along the existing stream corridor between the southeastern end of pond #1 and the northeastern end of pond #5. Harriott indicated that there was already some existing Atlantic white cedar in that stream reach, but there was room for improvements. Porutski suggested that the set of triple metal culverts be removed from this stream reach, as they would no longer be needed; a simple box culvert could replace them (this may provide better drainage behind the structure, and allow for better re-colonization of Atlantic white cedar). Carberry also said that it would probably be better for the anadromous fishery if pond #5 were to remain intact (as opposed to Harriott's original proposal), as it would be advantageous as a resting area for fry returning downstream. **He also pointed out that another fish ladder would be needed on the southeastern end of pond #1 if the objective was to pass fish north into to the headwaters of Westecunk Creek (without draining the upper pond); all agreed.** Tonnesen also suggested that the eastern-most arm of pond #1 possesses an old road (people occasionally attempt to drive on it when water levels are very low) that with some modifications could allow for isolation (from the main pond), draining, and wetlands establishment.

Harriott asked Carberry for information on retrofitting fish ladders on existing water control structures (specifically, can ladders be retrofitted on a new water control structure, if NJDEP must install it prior to initiation of the Corps' restoration at the site). Carberry said almost any water control structure can be retrofitted with a fish ladder, but costs are cheaper if the structures

are originally designed with passage in mind. He prefers the pre-fabricated ladders, and would definitely lean toward lowest cost technology. He feels the ladders should be on the order of about $50K to $60K. **The group concluded that it would be preferable economically (and possibly functionally) to install the fish ladders as part of the current move to replace the water control structures (as opposed to retrofitting them later).**

Porutski asked about the Corps' timing for restoration at NWS02. He stressed that the main water control structure is not in good shape, and will need to be replaced within a year or two at the most. Tonnesen concurred (he is often responsible for patching together the structure); he indicated that the boards are currently missing in the right section and only vegetation and debris is holding the water back here. Wilkinson asked about the Corps' cutoff for defining a "major project" (he thought it was $1 million), with the concern that designation could slow this project down. Porutski re-iterated safety concerns. **Both Tonnesen and Porutski stressed that the beaver population in the vicinity of the site has become very large; any restoration must take this into account and provide beaver elimination methods/technology**. The recent flooding from severe rains in northern New Jersey was also mentioned in the context of potential beaver-caused flooding at the site. **Based on a discussion of concerns for public safety, as well as the potential for illegal poaching of alewife, the group concluded that the fish ladder structures must be fenced in.**

NOTE: Subsequent to this meeting, Wilkinson indicated in a phone call to Harriott on 18 August 2000 that Tonnesen talked with several reputable professional anglers living along the lower and middle parts of Westecunk Creek (he has many contacts in this area). These contacts confirmed that there is definitely a current run of alewife up to the first blockage at site NWS03 (Silver Lake site). This finding confirms other anecdotal information gathered and presented by Versar during the site selection phase of the task, and bolsters current plans to re-establish the fishery in Westecunk Creek. Wilkinson indicated that he and Carberry were pleased with this finding, but stressed that it would still be prudent to conduct additional water chemistry and zooplankton studies on Westecunk Creek.

VERSAR, INC. 9200 Rumsey Road Columbia, Maryland 21045

FAX TRANSMITTAL

FAX No. (410-964-5156) CONFIRMATION NO. (410-964-9200)

Addressee	Organization	FAX Number
Don Wilkinson	NJDEP	(857) 785-0670
Hugh Carberry	NJDEP	(856) 629-5044
Ray Porutski	NJDEP	(609) 259-7479

FROM: Steve Harriott SH
ACCOUNT NO. 0590-022
PAGES: 4 total
DATE: August 23, 2000

****

Gentlemen,

Attached are minutes from our 16 August 2000 meeting at the NJDEP Southern Region Office, regarding Stafford Forge issues. Please let me know if there are any major points that I missed.

Could one of you guys do me a big favor and pass a copy of this on to Wayne? I do not have his fax number.

Thanks again for meeting with me; I really appreciated your feedback!

Steve

State of New Jersey
Department of Environmental Protection
Division of Fish, Game and Wildlife
Robert McDowell, Director
P.O. Box 400
Trenton, NJ 08625-0400
ph. 609-292-2965, fax 609-984-1414
Visit our Division Website: www.state.nj.us/dep/fgw

Christine Todd Whitman
Governor

Robert C. Shinn, Jr.
Commissioner

MEMORANDUM

TO: Helen Owens, Land Use Regulation Program

FROM: Dave Jenkins, Endangered and Nongame Species Program

SUBJECT: Barnegat Bay Ecosystem Site Selection Report

DATE: October 4, 2000

I have reviewed the comments that the Land Use Regulation Program (LURP) provided to Steve Harriot of Versar, Inc., regarding the above ecosystem restoration project feasibility study. I am concerned with your recommendation to eliminate the Barnegat Light Beach project (Item 18.) from the feasibility study. As you mention, I had expressed concern that the project, as initially proposed, would not likely provide the anticipated benefits to beach nesting birds. However, I have been working with Versar to modify this project so that it would enhance habitat for piping plovers and other endangered beach nesting birds. Specifically, we recommended the creation of a shallow, tidally-filled pond (~2-3 acres) behind the primary dune system to provide enhanced foraging habitat. This would be combined with enhancing nesting habitat by grading low lying dunes behind the primary dune system and depositing clam and/or oyster shell fragments to retard vegetation re-growth. These activities would take place east of the phragmites area described in the original proposal and your memo.

The Endangered and Nongame Species Program and the U.S. Fish and Wildlife Service strongly support the intent of this project and we are confident that, with the above described modification to the original proposal, the project will considerably improve nesting habitat for piping plovers, least terns, and black skimmers on an area that previously provided some of the best and most productive habitat for these birds in the state. While it might be just a matter of semantics, I believe it is important to view our recommendations as modifications to, rather than elimination of, the original proposal. The general location and intent of the original proposal is unchanged.

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Your letter to Versar also indicates that a plan such as described above would require the approval of the Borough of Barnegat Light. While I agree that we need to develop support for this project from the Borough of Barnegat Light and citizens, it is not clear that the project should require borough "approval" as the land targeted for the restoration work is entirely state-owned.

I look forward to continuing to work with Versar, USACOE, U.S. Fish and Wildlife Service, State Park Service, and LURP to hone this proposal so that it provides crucial habitat for endangered beach nesting birds within the bounds of state and federal land-use regulations. As I have mentioned previously, it is important that we begin to iron out possible regulatory snags to projects such as this one as habitat modification, creation, and enhancement will be playing an increasing role in our efforts to restore populations of critically imperiled coastal birds, such as the piping plover

cc. Steve Harriot, Versar, Inc.
Terry Fowler, U.S. Army Corps of Engineers, Phila. District
Annette Scherer, U.S. Fish and Wildlife Service, Pleasantville, NJ

From: <Eric_Schrading@fws.gov>
To: "STEVE HARRIOTT" <HARRIOTTSTE@versar.com>
Date: 10/5/00 4:48PM
Subject: Re: Barnegat/Phrag spraying

The cost estimates are generally correct...$12.00 / acre for spraying by fixed wing this year and closer to $40.00 / acre by helicopter. But it depends on how much you propose to do. If you plan on 20 acres at year 1, you may be paying $80.00 / acre so the helicopter pilot can make up their mobilization and demobilization costs. However, if you are doing several hundred acres, the cost is closer to what I mentioned. Economy of scale.

We did need pesticide use permits from NJDEP for the spraying and if the project is in the Pinelands, you also need Pinelands permits. The prescribed burning does require a permit from NJ Forest Fire Service, but this is relatively easy to get, especially if you do the burn in conjunction with them as we do.

Hope that answers your questions. Any others let me know.

Eric

Eric Schrading
Private Lands Coordinator
U.S. Fish and Wildlife Service
New Jersey Field Office
Phone: (609) 646-9310 x 46
Fax: (609) 646-0352

State of New Jersey

Christine Todd Whitman
Governor

Department of Environmental Protection
Division of Parks and Forestry
Office of Natural Lands Management
Natural Heritage Program
P.O. Box 404
Trenton, NJ 08625-0404
Tel. #609-984-1339
Fax. #609-984-1427

Robert C. Shinn, Jr.
Commissioner

October 12, 2000

Steve Harriott
Versar, Inc.
9200 Rumsey Road
Columbia, MD 21045-1934

Re: Barnegat Bay Ecosystem Restoration Sites

Dear Mr. Harriott:

Thank you for your data request regarding rare species information for the above referenced nineteen project sites in Ocean County.

The Natural Heritage Data Base has records for occurrences of rare species and/or natural communities that may be on or in the immediate vicinity of twelve of the project sites. The attached lists provide more information about these occurrences. **Because some species are sensitive to disturbance or sought by collectors, this information is provided to you on the condition that no specific locational data are released to the general public. This is not intended to preclude your submission of this information to regulatory agencies from which you are seeking permits.**

Also attached is a list of rare species and natural communities that have been documented from Ocean County. This county list can be used as a master species list for directing further inventory work. If suitable habitat is present at the project site, these species have potential to be present. If you have questions concerning the wildlife records or wildlife species mentioned in this response, we recommend you contact the Division of Fish and Wildlife, Endangered and Nongame Species Program.

The Natural Heritage Program reviews its data periodically to identify priority sites for natural diversity in the State. Included as priority sites are some of the State's best habitats for rare and endangered species and natural communities. Seven of these sites are located within or near the areas you have outlined. The table shows the correspondence between priority sites and project sites.

Natural Heritage Priority Site	Project Sites		
East Plains Fireshed	NWS02		
Manahawkin Bay Macrosite	ISS01	ISS02	ISS03
Ballanger Creek	TWS02		
Island Beach Macrosite	TWS39	ISS08	
Cedar Bonnet Island	ISS01		
Sedge Islands At Island Beach	ISS08		
Barnegat Light Site	TWS39		

Please refer to the enclosed Natural Heritage Priority Site Maps for the locations and boundaries of these sites. On the back of each Priority Site Map is a report describing the significance of the site.

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You may find the site biodiversity significance rating to be useful if you need to prioritize among the sites in your environmental assessment.

PLEASE SEE THE ATTACHED 'CAUTIONS AND RESTRICTIONS ON NHP DATA'.

Thank you for consulting the Natural Heritage Program. The attached invoice details the payment due for processing this data request. Feel free to contact us again regarding any future data requests.

Sincerely,

Thomas F. Breden
Supervisor

cc: Lawrence Niles
Thomas Hampton
NHP File No. 00-Ocean

NATURAL LANDS MANAGEMENT

CAUTIONS AND RESTRICTIONS ON NATURAL HERITAGE DATA

The quantity and quality of data collected by the Natural Heritage Program is dependent on the research and observations of many individuals and organizations. Not all of this information is the result of comprehensive or site-specific field surveys. Some natural areas in New Jersey have never been thoroughly surveyed. As a result, new locations for plant and animal species are continuously added to the data base. Since data acquisition is a dynamic, ongoing process, the Natural Heritage Program cannot provide a definitive statement on the presence, absence, or condition of biological elements in any part of New Jersey. Information supplied by the Natural Heritage Program summarizes existing data known to the program at the time of the request regarding the biological elements or locations in question. They should never be regarded as final statements on the elements or areas being considered, nor should they be substituted for on-site surveys required for environmental assessments. The attached data is provided as one source of information to assist others in the preservation of natural diversity.

This office cannot provide a letter of interpretation or a statement addressing the classification of wetlands as defined by the Freshwater Wetlands Act. Requests for such determination should be sent to the DEP Land Use Regulation Program, P.O. Box 401, Trenton, NJ 08625-0401.

This cautions and restrictions notice must be included whenever information provided by the Natural Heritage Database is published.

N.J. Department of Environmental Protection Division of Parks & Forestry

1
10 OCT 2000

POSSIBLY IN IMMEDIATE VICINITY OF PROJECT SITE NWS03
RARE SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
THE NEW JERSEY NATURAL HERITAGE DATABASE

NAME	COMMON NAME	FEDERAL STATUS	STATE STATUS	REGIONAL STATUS	GRANK	SRANK	DATE OBSERVED	IDENT.	LOCATION
*** Vascular plants									
CAREX BARRATTII	BARRATT'S SEDGE			LP	G3G4	S4	1911-05-07	Y	WEST CREEK.
UVULARIA PUBERULA VAR NITIDA	PINE BARREN BELLWORT		E		G5T3?	S2	1907-05-29	Y	WEST CREEK, NORTHEAST EDGE OF TOWN, NEAR WESTECUNK CREEK.

2 Records Processed

1
10 OCT 2000

POSSIBLY ON PROJECT SITE NWS02
RARE SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
THE NEW JERSEY NATURAL HERITAGE DATABASE

NAME	COMMON NAME	FEDERAL STATUS	STATE STATUS	REGIONAL STATUS	GRANK	SRANK	DATE OBSERVED	IDENT.	LOCATION
*** Vertebrates									
HYLA ANDERSONII	PINE BARRENS TREEFROG		E		G4	S3	1990-06-01		SEVERAL LOCATIONS IN STAFFORD FORGE WILDLIFE MANAGEMENT AREA, NORTH OF GARDEN STATE PARKWAY, EAGLESWOOD TWP.
*** Vascular plants									
RHYNCHOSPORA KNIESKERNII	KNIESKERN'S BEAKED RUSH	LT	E	LP	G1	S1	1994-10-21	Y	DISTURBED MOIST PATCH ALONG SOUTH SIDE OF TRAIL ALONG ABANDONED CRANBERRY BOG AT RAIL BRANCH JUNCTION WITH RESERVOIRS ALONG WESTECUNK CREEK, 0.45 MILES NORTH WEST OF BRIDGE OVER WESTECUNK CREEK (RT 606).

2 Records Processed

1
10 OCT 2000

POSSIBLY IN IMMEDIATE VICINITY OF PROJECT SITE NWS02
RARE SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
THE NEW JERSEY NATURAL HERITAGE DATABASE

NAME	COMMON NAME	FEDERAL STATUS	STATE STATUS	REGIONAL STATUS	GRANK	SRANK	DATE OBSERVED	IDENT.	LOCATION
*** Vertebrates									
ACCIPITER COOPERII	COOPER'S HAWK		T/T		G5	S3B,S4N	1995-06-08	Y	IN STAFFORD FORGE WILDLIFE MANAGEMENT AREA ALONG OLD FORGE ROAD, APPROXIMATELY 1.0 MILE ALONG THE ROAD AT BACK END (NORTH END) OF BOGS.

1 Records Processed

1
10 OCT 2000

POSSIBLY ON PROJECT SITE NWS01
RARE SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
THE NEW JERSEY NATURAL HERITAGE DATABASE

NAME	COMMON NAME	FEDERAL STATUS	STATE STATUS	REGIONAL STATUS	GRANK	SRANK	DATE OBSERVED	IDENT.	LOCATION
*** Vascular plants									
SCHIZAEA PUSILLA	CURLY GRASS FERN			LP	G3	S3	1996-09-10	Y	FRENCHES CRANBERRY BOGS, WEST SIDE OF ROUTE 9, NORTH OF MAYETTA.

1 Records Processed

1

10 OCT 2000

POSSIBLY ON OR IN IMMEDIATE VICINITY OF PROJECT SITE NWS01
RARE SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
THE NEW JERSEY NATURAL HERITAGE DATABASE

NAME	COMMON NAME	FEDERAL STATUS	STATE STATUS	REGIONAL STATUS	GRANK	SRANK	DATE OBSERVED	IDENT.	LOCATION
*** Vascular plants									
NARTHECIUM AMERICANUM	BOG ASPHODEL	C	E	LP	G2	S2	1907-07-22	Y	MAYETTA FRENCHES CRANBERRY BOG.

1 Records Processed

1

10 OCT 2000

IMMEDIATE VICINITY OF PROJECT SITE LAN05
RARE SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
THE NEW JERSEY NATURAL HERITAGE DATABASE

NAME	COMMON NAME	FEDERAL STATUS	STATE STATUS	REGIONAL STATUS	GRANK	SRANK	DATE OBSERVED	IDENT.	LOCATION
*** Vertebrates									
PANDION HALIAETUS	OSPREY		T/T		G5	S2B	1992-SUMMER		APPROXIMATELY 1/2 MILE WEST OF MANTOLOKING BRIDGE, BEHIND #92 MANTOLOKING ROAD.

1 Records Processed

1
10 OCT 2000

IMMEDIATE VICINITY OF PROJECT SITE LAN06
RARE SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
THE NEW JERSEY NATURAL HERITAGE DATABASE

NAME	COMMON NAME	FEDERAL STATUS	STATE STATUS	REGIONAL STATUS	GRANK	SRANK	DATE OBSERVED	IDENT.	LOCATION
*** Vertebrates									
PANDION HALIAETUS	OSPREY		T/T		G5	S2B	1992-SUMMER		APPROXIMATELY 1/2 MILE WEST OF MANTOLOKING BRIDGE, BEHIND #92 MANTOLOKING ROAD.

1 Records Processed

1
10 OCT 2000

ON OR IN IMMEDIATE VICINITY OF PROJECT SITE TWS39
RARE SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
THE NEW JERSEY NATURAL HERITAGE DATABASE

NAME	COMMON NAME	FEDERAL STATUS	STATE STATUS	REGIONAL STATUS	GRANK	SRANK	DATE OBSERVED	IDENT.	LOCATION
*** Vertebrates									
CHARADRIUS MELODUS	PIPING PLOVER	LT	E		G3	S1B	1996-06-??	Y	BARNEGAT LIGHT BORO, BETWEEN BARNEGAT INLET AND 19TH STREET.
STERNA ANTILLARUM	LEAST TERN		E		G4	S1B	1996-SUMMER	Y	BARNEGAT LIGHT BORO, BETWEEN BARNEGAT INLET AND 19TH STREET.

2 Records Processed

1
10 OCT 2000

IMMEDIATE VICINITY OF PROJECT SITE TWE39
RARE SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
THE NEW JERSEY NATURAL HERITAGE DATABASE

NAME	COMMON NAME	FEDERAL STATUS	STATE STATUS	REGIONAL STATUS	GRANK	SRANK	DATE OBSERVED	IDENT.	LOCATION
*** Vertebrates									
STERNA ANTILLARUM	LEAST TERN		E		G4	S1B	1986-SUMMR	Y	BARNEGAT INLET, OCEAN TWP. ISLAND IN BARNEGAT INLET BETWEEN THE SEDGE ISLANDS AND BARNEGAT LIGHTHOUSE.
STERNA ANTILLARUM	LEAST TERN		E		G4	S1B	1993-??-??	Y	ISLAND BEACH SOUTH, BERKELEY TWP.

2 Records Processed

1
10 OCT 2000

POSSIBLY ON PROJECT SITE ISS03
RARE SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
THE NEW JERSEY NATURAL HERITAGE DATABASE

NAME	COMMON NAME	FEDERAL STATUS	STATE STATUS	REGIONAL STATUS	GRANK	SRANK	DATE OBSERVED	IDENT.	LOCATION
*** Vertebrates									
EGRETTA THULA	SNOWY EGRET		S/S		G5	S3B,S4N	1983-06-??	Y	HIGH ISLAND, LONG BEACH TWP. W. OF BRANT BEACH.
NYCTICORAX NYCTICORAX	BLACK-CROWNED NIGHT-HERON		T/S		G5	S3B,S4N	1983-06-??	Y	HIGH ISLAND, LONG BEACH TWP. W. OF BRANT BEACH.
PLEGADIS FALCINELLUS	GLOSSY IBIS		D/S		G5	S3B,S4N	1983-06-??	Y	HIGH ISLAND, LONG BEACH TWP. W. OF BRANT BEACH.
STERNA NILOTICA	GULL-BILLED TERN		S		G5	S1B	1985-06-??	Y	LOCATED ON HIGH ISLAND, ON THE BAY SIDE OF BRANT BEACH AND NORTH OF SAND ISLAND.
*** Other types									
COASTAL HERON ROOKERY	COASTAL HERON ROOKERY				GU	S3	1983-06-??	Y	HIGH ISLAND, LONG BEACH TWP. W. OF BRANT BEACH.

5 Records Processed

1
10 OCT 2000

POSSIBLY ON PROJECT SITE ISS02
RARE SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
THE NEW JERSEY NATURAL HERITAGE DATABASE

NAME	COMMON NAME	FEDERAL STATUS	STATE STATUS	REGIONAL STATUS	GRANK	SRANK	DATE OBSERVED	IDENT.	LOCATION
*** Vertebrates									
CIRCUS CYANEUS	NORTHERN HARRIER		E/U		G5	S1B,S3N	1983-07-14	Y	FLAT ISLAND, LONG BEACH TWP.
EGRETTA CAERULEA	LITTLE BLUE HERON		S/S		G5	S2B	1985-06-??	Y	FLAT ISLAND, LONG BEACH TWP. SOUTHWEST OF SHIP BOTTOM.
EGRETTA THULA	SNOWY EGRET		S/S		G5	S3B,S4N	1985-06-??	Y	FLAT ISLAND, LONG BEACH TWP. SW OF SHIP BOTTOM.
EGRETTA TRICOLOR	TRICOLORED HERON		INC/S		G5	S3B	1985-06-??	Y	FLAT ISLAND, LONG BEACH TWP. SW OF SHIP BOTTOM.
NYCTANASSA VIOLACEA	YELLOW-CROWNED NIGHT-HERON		T/T		G5	S2B	1977-06-??	Y	FLAT ISLAND, LONG BEACH TWP., SW OF SHIP BOTTOM.
NYCTICORAX NYCTICORAX	BLACK-CROWNED NIGHT-HERON		T/S		G5	S3B,S4N	1985-06-??	Y	FLAT ISLAND, LONG BEACH TWP. SW OF SHIP BOTTOM.
PLEGADIS FALCINELLUS	GLOSSY IBIS		D/S		G5	S3B,S4N	1985-06-??	Y	FLAT ISLAND, LONG BEACH TWP. SW OF SHIP BOTTOM.
*** Other types									
COASTAL HERON ROOKERY	COASTAL HERON ROOKERY				GU	S3	1985-06-??	Y	FLAT ISLAND, LONG BEACH TWP. SW OF SHIP BOTTOM.

8 Records Processed

1
10 OCT 2000

POSSIBLY ON PROJECT SITE 1SS01
RARE SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
THE NEW JERSEY NATURAL HERITAGE DATABASE

NAME	COMMON NAME	FEDERAL STATUS	STATE STATUS	REGIONAL STATUS	GRANK	SRANK	DATE OBSERVED	IDENT.	LOCATION
*** Vertebrates									
CHARADRIUS MELODUS	PIPING PLOVER	LT	E		G3	S1B	1985-07-??	Y	CEDAR BONNET ISLAND IN MANAHAWKIN BAY, SOUTH OF ROUTE 72.
CIRCUS CYANEUS	NORTHERN HARRIER		E/U		G5	S1B,S3N	1986-07-??	Y	CEDAR BONNET ISLAND, STAFFORD TWP.
RYNCHOPS NIGER	BLACK SKIMMER		E		G5	S1B	1982-??-??	Y	SOUTHWEST CEDAR BONNET ISLAND SOUTH OF RT. #72.
STERNA ANTILLARUM	LEAST TERN		E		G4	S1B	1992-SUMMR	Y	CEDAR BONNET ISLAND. ISLAND IN THE MANAHAWKIN BAY, CROSSED BY ROUTE 72. COLONY ON THE SOUTH SIDE OF THE ROAD.
STERNA DOUGALLII DOUGALLII	ROSEATE TERN	LE	E		G4T3	SHB	1987-??-??	Y	SMALL ISLANDS ON SOUTHERN END OF CEDAR BONNET ISLAND.
STERNA HIRUNDO	COMMON TERN		D/S		G5	S3B	1983-06-??	Y	SCATTERED COLONIES ARE FOUND ON THE SOUTHERN HALF OF CEDAR BONNET, EAST OF THOROFARE ISLAND.

6 Records Processed

1
10 OCT 2000

IMMEDIATE VICINITY OF PROJECT SITE ISS08
RARE SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
THE NEW JERSEY NATURAL HERITAGE DATABASE

NAME	COMMON NAME	FEDERAL STATUS	STATE STATUS	REGIONAL STATUS	GRANK	SRANK	DATE OBSERVED	IDENT.	LOCATION
*** Vertebrates									
PANDION HALIAETUS	OSPREY		T/T		G5	S2B	1987-??-??	Y	W. SEDGE IS., OFF SOUTHERN END OF ISLAND BEACH ST. PARK.

1 Records Processed

1
10 OCT 2000

IMMEDIATE VICINITY OF PROJECT SITE TWC21
RARE SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
THE NEW JERSEY NATURAL HERITAGE DATABASE

NAME	COMMON NAME	FEDERAL STATUS	STATE STATUS	REGIONAL STATUS	GRANK	SRANK	DATE OBSERVED	IDENT.	LOCATION
*** Vascular plants									
PYCNANTHEMUM SETOSUM	AWNED MOUNTAIN MINT				G3?	S2	1993-??-??	Y	WEST OF CABLE ROAD AND EAST OF DOCK ROAD AND A SMALL EMBANKMENT OF OYSTER CREEK.
PYCNANTHEMUM SETOSUM	AWNED MOUNTAIN MINT				G3?	S2	1993-??-??	Y	SOUTH OF ORLANDO DRIVE AND NORTH OF OYSTER CREEK, LACEY TWP.
PYCNANTHEMUM SETOSUM	AWNED MOUNTAIN MINT				G3?	S2	1993-??-??	Y	SANDS HARBOR POINT, NORTHERNMOST TIP, NORTH OF BAY PARKWAY.

3 Records Processed

1

10 OCT 2000

POSSIBLY ON PROJECT SITE TWS02

RARE SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN

THE NEW JERSEY NATURAL HERITAGE DATABASE

NAME	COMMON NAME	FEDERAL STATUS	STATE STATUS	REGIONAL STATUS	GRANK	SRANK	DATE OBSERVED	IDENT.	LOCATION
*** Vascular plants									
ERYNGIUM AQUATICUM	MARSH RATTLESNAKE MASTER				G4	S3	1985-09-11	Y	BALLANGER CREEK, CA. 0.5 MI. S. OF RT. 9 AND CA. 3 MI. E. OF NEW GRETNA.

1 Records Processed

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APPENDIX B

FIELD DATA SHEETS

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Weston Inc.

BARNEGAT BAY ENVIRONMENTAL TESTING
FISH PASSAGE SITE DATA

Location ID/Name: DOUBLE TROUBLE **Date:** 26 MAY 2000
Photo Rolls/Frames: DISP. #1 **Crew:** SPH/MP
Weather Conditions: SUNNY, W WIND 10-15 KNOTS **Air Temp.:** 70°F

Size and description of water control structures: ~6 FT. FROM TOP OF CONCRETE SPILLWAY TO STREAM

Water Quality

Sampling Location	pH	Salinity (o/oo)	D.O. (mg/L)	Specific Conductivity (mS/cm)	Temp. (°C)	Turbidity (NTU)
W1 (SW EDGE OF POND)	4.11	0.02	8.76	0.051	17.93	18.9
W2 (DOWNSTREAM)	4.07	0.01	10.28	0.033	17.37	17.8
W3 (upstream)	3.90	0.01	9.68	0.032	17.46	18.7

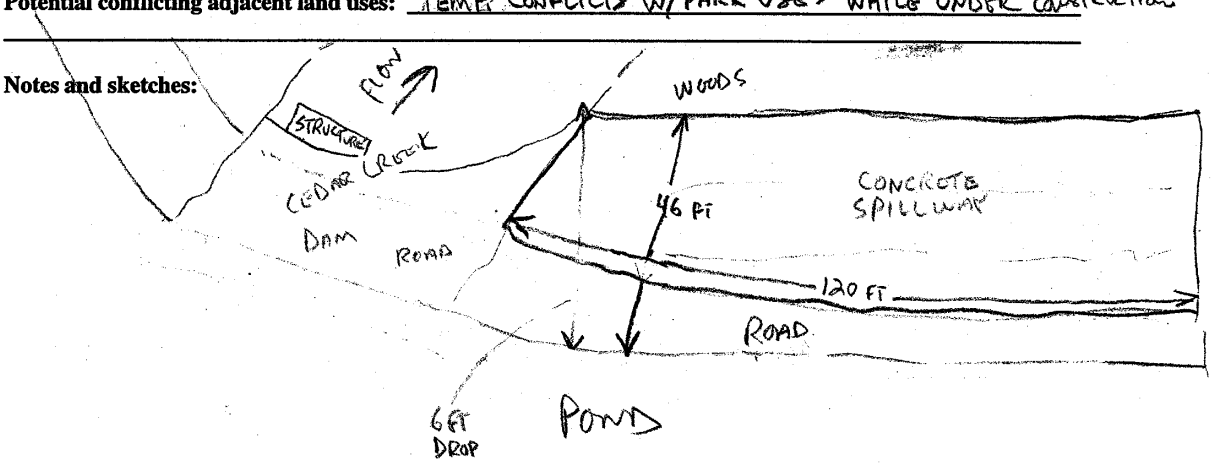
Upstream/Downstream physical and riparian habitat data sheets completed? Y/N (if yes, attach)

Wildlife observed:

Potential impacts to existing systems: NONE – LADDERS COULD BE INSTALLED IN EXISTING SPILLWAY WITH MINIMAL DISRUPTION TO EXISTING STRUCTURE

Potential conflicting adjacent land uses: TEMP. CONFLICTS W/ PARK USES WHILE UNDER CONSTRUCTION

Notes and sketches:



Weston Inc.

Barnegat Bay Environmental Site Testing
Habitat Assessment Field Data Sheet—Low Gradient Streams (Front)

STREAM NAME (Ed) or Creek	LOCATION Double Trouble	
STATION # upstream of Double Trouble	RIVER BASIN	
INVESTIGATORS M. Perot, S. Harriott		
FORM COMPLETED BY M. Perot	DATE 5-26-00 TIME 1245 (AM) PM	REASON FOR SURVEY Barnegat Site Testing

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 (18) 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 (19) 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 (19) 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 (16)	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 (18) 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

NOTES:

mostly logs

Some sand deposition in pools + behind logs

observed
eel (2)
grass pickerel
dragonfly (adult)
Caddisfly
mayfly
dytiscidae (diving beetle)

Barnegat Bay Environmental Site Testing
Habitat Assessment Field Data Sheet—Low Gradient Streams (Back)

STATION #	DATE

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 (17) 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	(15) 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 10 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 9 (LB)	Left Bank 10 (9)	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank (10) 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 9 (LB)	Left Bank 10 (9)	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank (10) 9	8 7 6	5 4 3	2 1 0

NOTES:

Side channel from bay channel + influences reach

Canoe launch are left bank

Canoe launch road ⊥ to creek

Total Score _____

Versar INC.

Barnegat Bay Environmental Site Testing
Physical Characterization/Water Quality Field Data Sheet
(Front)

STREAM NAME	LOCATION	
STATION #	RIVER BASIN	
INVESTIGATORS		
FORM COMPLETED BY	DATE _____ TIME _____ AM PM	REASON FOR SURVEY

WEATHER CONDITIONS

Now		Past 24 hours
☐	storm (heavy rain)	☐
☐	rain (steady rain)	☐
☐	showers (intermittent)	☐
___% ☐	%cloud cover	☐ ___%
☑	clear/sunny	☑

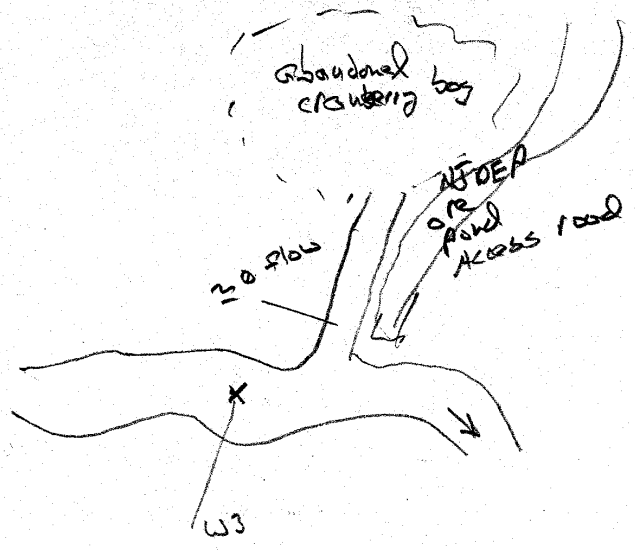
Has there been a heavy rain in the last 7 days? ☑ Yes ☐ No

Air Temperature 75 °C F

Other_____

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)



STREAM CHARACTERIZATION

Stream Subsystem
☑ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☑ Coldwater ☐ Warmwater

Stream Origin
☐ Glacial ☐ Spring-fed
☐ Non-glacial montane ☐ Mixture of origins
☑ Swamp and bog ☐ Other_____

Catchment Area_____km²

Versar INC.

Barnegat Bay Environmental Site Testing
Physical Characterization/Water Quality Field Data Sheet (Back)

STATION #	DATE

WATERSHED FEATURES	**Predominant Surrounding Landuse** ☑ Forest ☐ Commercial ☐ Field/Pasture ☐ Industrial ☐ Agricultural ☐ Other _____ ☐ Residential **Local Watershed NPS Pollution** ☑ No evidence ☐ Some potential sources ☐ Obvious sources **Local Watershed Erosion** ☑ None ☐ Moderate ☐ Heavy
RIPARIAN VEGETATION (18 meter buffer)	**Indicate the dominant type and record the dominant species present** ☑ Trees ☐ Shrubs ☐ Grasses ☐ Herbaceous **dominant species present** Red Maple, ALWC
INSTREAM FEATURES	**Estimated Reach Length** 300 ~~m~~ ft **Estimated Stream Width** 25 ft ~~m~~ **Sampling Reach Area** _____ m² **Area in km² (m²x1000)** _____ km² **Estimated Stream Depth** 32" ~~m~~ **Surface Velocity (at thalweg)** _____ m/sec 1.5 ft/sec **Canopy Cover** ☐ Partly open ☑ Partly shaded ☐ Shaded **High Water Mark** 2 ft ~~m~~ **Proportion of Reach Represented by Stream Morphology Types** ☐ Riffle ____ % ☑ Run 85 % ☑ Pool 15 % **Channelized** ☐ Yes ☑ No **Dam Present** ☐ Yes ☑ No
LARGE WOODY DEBRIS	**LWD** _____ m² **Density of LWD** _____ m²/km² (LWD/ reach area)
AQUATIC VEGETATION	**Indicate the dominant type and record the dominant species present** ☑ Rooted emergent ☑ Rooted submergent ☐ Rooted floating ☐ Free floating ☐ Floating Algae ☐ Attached Algae **dominant species present** potamogeton, rush (scirpus) **Portion of the reach with aquatic vegetation** 5 %
WATER QUALITY See datasheet for double probe W3	**Temperature** _____ °C **Specific Conductance** _____ mS/cm **Dissolved Oxygen** _____ mg/L **pH** _____ **Turbidity** _____ NTU **WQ Instrument Used** _____ **Water Odors** ☑ Normal/None ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Fishy ☐ Other _____ **Water Surface Oils** ☐ Slick ☐ Sheen ☐ Globs ☐ Flecks ☑ None ☐ Other _____ **Turbidity (if not measured)** ☐ Clear ☐ Slightly turbid ☐ Turbid ☐ Opaque ☑ Stained tannin ☐ Other _____
SEDIMENT/ SUBSTRATE	**Odors** ☑ Normal ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Anaerobic ☐ None ☐ Other _____ **Oils** ☑ Absent ☐ Slight ☐ Moderate ☐ Profuse **Deposits** ☐ Sludge ☐ Sawdust ☐ Paper fiber ☑ Sand in some areas ☐ Relict shells ☐ Other _____ **Looking at stones which are not deeply embedded, are the undersides black in color?** ☐ Yes ☐ No none present

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**	**Substrate Type**	**Characteristic**	**% Composition in Sampling Area**
Bedrock			Detritus	sticks, wood, coarse plant materials (CPOM)	20%
Boulder	> 256 mm (10")				
Cobble	64-256 mm (2.5"-10")		Muck-Mud	black, very fine organic (FPOM)	10%
Gravel	2-64 mm (0.1"-2.5")	40			
Sand	0.06-2mm (gritty)	60	Marl	grey, shell fragments	
Silt	0.004-0.06 mm				
Clay	< 0.004 mm (slick)				

Versar INC.

Barnegat Bay Environmental Site Testing

Habitat Assessment Field Data Sheet—Low Gradient Streams (Front)

STREAM NAME CEDAR CREEK	LOCATION DOUBLE TROUBLE	
STATION # DOWNSTREAM	RIVER BASIN	
INVESTIGATORS SPH / MP		
FORM COMPLETED BY SPH	DATE 26 MAR 2000 TIME 10:50 (AM) PM	REASON FOR SURVEY BARNEGAT TESTING

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 (17) 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 (19) 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 (18) 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	(20) 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	(20) 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

NOTES:

Barnegat Bay Environmental Site Testing
Habitat Assessment Field Data Sheet—Low Gradient Streams (Back)

STATION #	DATE

NOTES:

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 (18) 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	(15) 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 10 (LB)	Left Bank (10) 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank (10) 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 10 (LB)	Left Bank (10) 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank (10) 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 9 (LB)	Left Bank 10 (9)	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank (10) 9	8 7 6	5 4 3	2 1 0

Total Score _____

Barnegat Bay Environmental Site Testing
Physical Characterization/Water Quality Field Data Sheet
(Front)

STREAM NAME	LOCATION	
STATION #	RIVER BASIN	
INVESTIGATORS		
FORM COMPLETED BY	DATE _____ TIME _____ AM PM	REASON FOR SURVEY

WEATHER CONDITIONS

Now		Past 24 hours
☐	storm (heavy rain)	☐
☐	rain (steady rain)	☐
☐	showers (intermittent)	☐
___%☐	%cloud cover	☐ ___%
☒	clear/sunny	☒

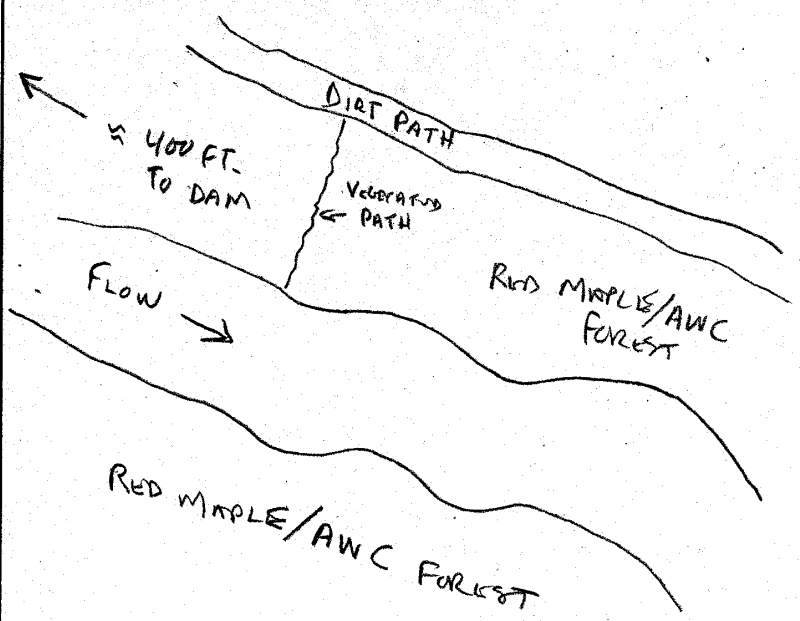
Has there been a heavy rain in the last 7 days? ☒ Yes ☐ No

Air Temperature 75 °F

Other_____

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)



STREAM CHARACTERIZATION

Stream Subsystem
☒ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☐ Coldwater ☒ Warmwater

Stream Origin
☐ Glacial
☐ Non-glacial montane
☒ Swamp and bog
☐ Spring-fed
☐ Mixture of origins
☐ Other_____

Catchment Area_____km²

Versar INC.

Barnegat Bay Environmental Site Testing
Physical Characterization/Water Quality Field Data Sheet (Back)

STATION #	DATE

WATERSHED FEATURES	**Predominant Surrounding Landuse** ☒ Forest ☐ Commercial ☐ Field/Pasture ☐ Industrial ☐ Agricultural ☐ Other _____ ☐ Residential **Local Watershed NPS Pollution** ☒ No evidence ☐ Some potential sources ☐ Obvious sources **Local Watershed Erosion** ☒ None ☐ Moderate ☐ Heavy
RIPARIAN VEGETATION (18 meter buffer)	**Indicate the dominant type and record the dominant species present** ☒ Trees ☐ Shrubs ☐ Grasses ☐ Herbaceous **dominant species present** AWC, RED MAPLE
INSTREAM FEATURES	**Estimated Reach Length** 300 ~~m~~ FT. **Estimated Stream Width** 30 ~~m~~ FT. **Sampling Reach Area** _____ m^2 **Area in km^2 (m^2x1000)** _____ km^2 **Estimated Stream Depth** 31 IN ~~m~~ **Surface Velocity (at thalweg)** _____ m/sec 5SEC/10FT. **Canopy Cover** ☐ Partly open ☒ Partly shaded ☐ Shaded **High Water Mark** 2 FT ~~m~~ **Proportion of Reach Represented by Stream Morphology Types** ☐ Riffle _____ % ☐ Run _____ % ☐ Pool _____ % **Channelized** ☐ Yes ☒ No **Dam Present** ☒ Yes ☐ No
LARGE WOODY DEBRIS	**LWD** _____ m^2 **Density of LWD** _____ m^2/km^2 (LWD/ reach area)
AQUATIC VEGETATION	**Indicate the dominant type and record the dominant species present** ☐ Rooted emergent ☒ Rooted submergent ☐ Rooted floating ☐ Free floating ☐ Floating Algae ☒ Attached Algae **dominant species present** NOT KNOWN **Portion of the reach with aquatic vegetation** 30 %
WATER QUALITY SEE DATA SHEET	**Temperature** _____ °C **Specific Conductance** _____ mS/cm **Dissolved Oxygen** _____ mg/L **pH** _____ **Turbidity** _____ NTU **WQ Instrument Used** _____ **Water Odors** ☒ Normal/None ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Fishy ☐ Other _____ **Water Surface Oils** ☐ Slick ☐ Sheen ☐ Globs ☐ Flecks ☒ None ☐ Other _____ **Turbidity (if not measured)** ☐ Clear ☐ Slightly turbid ☐ Turbid ☐ Opaque ☐ Stained ☒ Other TANINS
SEDIMENT/ SUBSTRATE	**Odors** ☐ Normal ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Anaerobic ☒ None ☐ Other _____ **Oils** NONE ☐ Absent ☐ Slight ☐ Moderate ☐ Profuse **Deposits** NONE ☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand ☐ Relict shells ☐ Other _____ **Looking at stones which are not deeply embedded, are the undersides black in color?** ☐ Yes ☒ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**	**Substrate Type**	**Characteristic**	**% Composition in Sampling Area**
Bedrock			Detritus	sticks, wood, coarse plant materials (CPOM)	5%
Boulder	> 256 mm (10")				
Cobble	64-256 mm (2.5"-10")		Muck-Mud	black, very fine organic (FPOM)	3%
Gravel	2-64 mm (0.1"-2.5")	80%			
Sand	0.06-2mm (gritty)	20%	Marl	grey, shell fragments	NONE
Silt	0.004-0.06 mm				
Clay	< 0.004 mm (slick)				

⇒ GRAVEL IS ARMORED W/ PERIPHYTON

BARNEGAT BAY ENVIRONMENTAL TESTING
ISLAND SITE DATA

Location ID/Name: ISS01 **Date:** 31 MAY 2000 [SEVERAL FIELD VISITS TO SITE ON DIFFERENT DATES]
Photo Rolls/Frames: DISP. #3 **Crew:** SPH, FSK
Weather Conditions: SUNNY/P. CLOUDY **Air Temp.:** 75°F

Sediment type(s) present: FINE TO MEDIUM SANDS

Is wetlands or SAV present? Y/N (if yes, map extent on aerial photograph) *- NEED FURTHER FIELD VERIFICATION
Species present: *- NEED TO ALSO MEASURE WIDTH OF BERM

Average height above mean high water: VARIES CONSIDERABLY - SEE NOTES, BELOW

Wildlife observed: RED FOX, YELLOW WARB, MD YELLOWTHROAT, WE. VIREO, DIAMONDBACK TERRAPIN

Potential impacts to existing systems: EXISTING ADJACENT TIDAL WETLANDS AND PHRAGMITES WETLANDS.

Potential conflicting adjacent land uses: RESIDENCES, MARINAS, AND ROUTE 72 ARE WITHIN 500 FT. OF PARTS OF THE SITE. COULD BE CONFLICTS WITH SPRAYING HERBICIDES.

Notes and sketches: OPEN SANDY AREA IN SE APPEARS TO BE (HAVE BEEN?) HEAVILY USED BY DIAMONDBACK TERRAPINS - SCRAPES & EGGSHELLS EVERYWHERE HERE. FOX DENS WERE PRESENT HERE AND IN THE CENTRAL OPEN AREA, HOWEVER. THE FOX DENS APPEAR VERY CURRENT; BIRD REMAINS LITTER THE TWO OPEN AREAS. POISON IVY IS VERY ABUNDANT IN ALL UPLAND HABITATS IN THE NORTHERN PART OF THE SITE (SO ARE TICKS & MOSQUITOS) MAKING ACCESS FROM THE NORTH VERY DIFFICULT. BERMS WERE OBSERVED IN THE W, S, AND E PARTS OF THE SITE, BUT NOT IN THE NORTH (ARE SOME PLACES FILLED TO TOP OR OVER THE TOP?). THE TWO OPEN, SANDY AREAS ARE THE HIGHEST PLACES ON THE SITE, AND APPEAR TO BE ABOUT 10 TO 12 FEET ABOVE MHW. THE AVERAGE HEIGHT OF THE FILLED AREAS (ANYWHERE WHERE THERE ISN'T TIDAL MARSH) APPEARS TO BE ABOUT 7 TO 10 FT. ABOVE MHW. THE WET PHRAGMITES AREAS APPEAR TO BE ABOUT 3 FT. AND LESS ABOVE MHW; THE TIDAL MARSH IS 1 FT. AND LESS ABOVE MHW.

Checklist

- ✓ re-evaluate restoration concepts
- ✓ map site boundaries
- ✓ map vegetation & land cover
- ✓ map on-site & adjacent wetlands

WE NOTED SEVERAL HELICOPTERS WITH SPRAY NOZZLES FLYING VERY CLOSE TO THE SITE WHEN WE WERE THERE ON 25 MARCH. GIVEN THE ABUNDANCE OF MOSQUITOS IN THE AREA OF THIS SITE, WE GUESSED THEY WERE SPRAYING INSECTICIDES. (HAD TO ABANDON OUR VISIT)

BARNEGAT BAY ENVIRONMENTAL TESTING
WETLAND SITE DATA

Location ID/Name: TWS02 **Date:** 23 MAY 2000
Photo Rolls/Frames: #1 (END), #2 (START) **Crew:** SPH & MP
Weather conditions: PARTLY CLOUDY **Air Temp.:** 70°F

Sediment type(s) present: FINE SAND/ALL BERMS

Size of fill, berms, water control structures, etc.: LOWER BERM IS 20 FT (WIDE) X 3 FT (TALL) X 400 FT (LONG)
PARTIALLY BREACHED BEAVER DAM IS 8 FT. WIDE. CONSTRUCTED OF FINE SAND.
- WATER DROPS ≈ 28 INCHES FROM POND LEVEL TO STREAM (AT BREACHED BEAVER DAM)
⇒ MIDDLE BERM: 17 FT X 3 FT X 400 FT., CONSTRUCTED OF FINE SAND.
↳ BREACH IS 15 FT WIDE
⇒ UPPER BERM: 17 FT. X 3 FT. X 200 FT.
- CONSTRUCTED OF FINE SAND
- SEVERAL SMALL BREACHES, BIGGEST IS ABOUT 3 FT.

Water Quality

Sampling Location	pH	Salinity (o/oo)	D.O. (mg/L)	Specific Conductivity (mS/cm)	Temp. (°C)	Turbidity (NTU)
W1 (LOWER POND)	5.02	0.03	3.45	0.059	14.30	18.3
W2 (TIDAL, BELOW POND)	5.44	0.15	8.58	0.039	14.42	22.1
W3 (W. SIDE OF RT. 9)	5.67	0.09	1.54	0.195	14.43	105.5
W4 (E. SIDE OF RT. 9)	4.56	0.03	5.77	0.066	16.16	21.7

- STRUCTURE ON E. SIDE OF ROUTE 9 STAMPED "1921"

Potential for fish passage? Y/N (if yes, complete instream and riparian data sheets and attach)

Wildlife observed: GC FLYCATCHER, ACADIAN FLY, BG. GNAT, ROUGH WINGED SWALLOW, ACRODIA SP., BULLFROG, HOUSE WREN, OVENBIRD, TREE SWALLOW, LEOPARD FROG

Potential impacts to existing systems: MAPLE/BLACK GUM FOREST IMMED. BELOW LOWER BERM (?)

Potential conflicting adjacent land uses: NOTE NO APPARENT CONNECTION BETWEEN E SIDE POND & "STREAM" W OF ROUTE #9

Notes and sketches: * - AVERAGE POND DEPTH IS 2½ TO 3 FT, W/ SOME DEEPER AREAS (OLD CHANNELS?)
* - SLIGHTLY TIDAL TO BERM DAM & ≈ 2 FT. TIDE IMMED. BELOW SITE

Checklist
- ✓ re-evaluate restoration concepts
- ✓ map site boundaries
- ✓ map vegetation & land cover
- ✓ map on-site & adjacent wetlands
- ✓ assess up/downstream habitats

W2 DEPTH = 9.5" V = 10 ft/120 sec
CHANNEL WIDTH = 19 FT.
INVERTS = SCUDS, MUD CRAB, POLYCHAETE WORMS
RIGHT BANK = NL CATTAILS/PHRAG
LEFT BANK = PHRAG

⇒ APPEARS BOG WAS ABANDONED & 3 BERMS FELL INTO DISREPAIR & WERE BREACHED AT THE MAIN CREEK CHANNEL. AWC RE-COLONIZED THE DRAINED SITE. BEAVERS PLUGGED THE BREACHES, RE-FLOODED THE PONDS, & KILLED THE AWC (CURRENT STATE) BECAUSE WATER LEVEL TOO HIGH.

Weston INC.

Barnegat Bay Environmental Site Testing
Habitat Assessment Field Data Sheet—Low Gradient Streams (Front)

STREAM NAME Ballanger Creek	LOCATION downstream of TW502	
STATION # downstream TW502	RIVER BASIN	
INVESTIGATORS M. Perot, S. Harriott		
FORM COMPLETED BY M. Perot	DATE 5-23-00 TIME 11:30 (AM) PM	REASON FOR SURVEY Barnegat Site Testing

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 7	20 19 18 17 16	15 14 13 12 11	10 9 8 (7) 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE 7	20 19 18 17 16	15 14 13 12 11	10 9 8 (7) 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE 8	20 19 18 17 16	15 14 13 12 11	10 9 (8) 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 16	20 19 18 17 (16)	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 20	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

NOTES:
tidal creek through phragmites + cattail marsh sandy bottom w/ some organic matter (cattail leaves + LOM)

relatively uniform

V. uniform bottom

mud banks fairly stable + not moving

high tide is about 2 ft. above bank full

Versar INC.

Barnegat Bay Environmental Site Testing
Habitat Assessment Field Data Sheet—Low Gradient Streams (Back)

STATION # downstream of TW502	DATE 5-23-00

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 20	(20) 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE 10	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 6 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 6 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 6 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

NOTES:

Mostly Natural

Cattails + Frag. covered both banks but open space b/w stems

Some trash from down upstream - no human lands w/in 100+m both sides of stream.

Total Score _____

for this worksheet - this is considered the channel, so high tide is considered flooding.

Versar INC.

Barnegat Bay Environmental Site Testing
Physical Characterization/Water Quality Field Data Sheet
(Front)

STREAM NAME Ballenger Creek	LOCATION downstream of TUS02	
STATION # downstream of TUS02	RIVER BASIN	
INVESTIGATORS M. Perot, S. Harnett		
FORM COMPLETED BY M. Perot	DATE 5-23-00 TIME 11:30 AM PM	REASON FOR SURVEY Barnegat Site Testing

WEATHER CONDITIONS

Now		Past 24 hours
☐	storm (heavy rain)	☐
☐	rain (steady rain)	☑
☐	showers (intermittent)	☐
99 % ☑	%cloud cover	☑ 100 %
☐	clear/sunny	☐

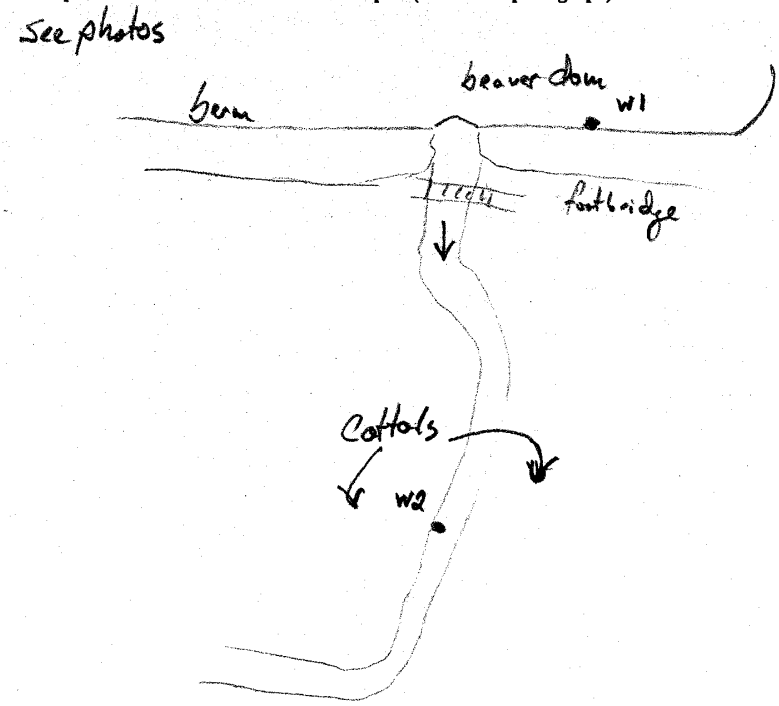
Has there been a heavy rain in the last 7 days? ☐ Yes ☐ No unknown

Air Temperature 70 °F

Other_____

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)



STREAM CHARACTERIZATION

Stream Subsystem
☐ Perennial ☐ Intermittent ☑ Tidal

Stream Type
☐ Coldwater ☑ Warmwater

Stream Origin
☐ Glacial
☐ Non-glacial montane
☑ Swamp and bog
☐ Spring-fed
☐ Mixture of origins
☐ Other_____

Catchment Area_____km²

Weston INC.

Barnegat Bay Environmental Site Testing
Physical Characterization/Water Quality Field Data Sheet (Back)

STATION # downstream of TWS02	DATE 5-23-00

WATERSHED FEATURES	**Predominant Surrounding Landuse** ☑ Forest ☐ Commercial ☐ Field/Pasture ☐ Industrial ☐ Agricultural ☑ Other former cranberry bog ☐ Residential **Local Watershed NPS Pollution** ☐ No evidence ☑ Some potential sources ☐ Obvious sources **Local Watershed Erosion** ☑ None ☐ Moderate ☐ Heavy
RIPARIAN VEGETATION (18 meter buffer)	**Indicate the dominant type and record the dominant species present** ☑ Trees ☐ Shrubs ☐ Grasses ☐ Herbaceous **dominant species present** AWC, Red maple, highbush blueberry
INSTREAM FEATURES	**Estimated Reach Length** 300 ft m **Estimated Stream Width** 19 ft m **Sampling Reach Area** _____ m^2 **Area in km^2 (m^2x1000)** _____ km^2 **Estimated Stream Depth** 0.8 ft m **Surface Velocity (at thalweg)** 0.08 ft/sec **Canopy Cover** – open ☐ Partly open ☐ Partly shaded ☐ Shaded **High Water Mark** 2.5 ft m **Proportion of Reach Represented by Stream Morphology Types** ☐ Riffle ____ % ☑ Run 80 % ☑ Pool 20 % **Channelized** ☐ Yes ☑ No **Dam Present** ☑ Yes ☐ No upstream
LARGE WOODY DEBRIS	**LWD** _____ m^2 **Density of LWD** _____ m^2/km^2 (LWD/ reach area)
AQUATIC VEGETATION	**Indicate the dominant type and record the dominant species present** ☐ Rooted emergent ☑ Rooted submergent ☐ Rooted floating ☐ Free floating ☐ Floating Algae ☐ Attached Algae **dominant species present** potamogeton **Portion of the reach with aquatic vegetation** <5 %
WATER QUALITY	**Temperature** 14.42 °C **Specific Conductance** 0.039 mS/cm **Dissolved Oxygen** 8.58 mg/L **pH** 5.44 **Turbidity** 22.1 NTU **WQ Instrument Used** YSI Salinity = 0.15 **Water Odors** ☑ Normal/None ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Fishy ☐ Other _____ **Water Surface Oils** ☐ Slick ☐ Sheen ☐ Globs ☐ Flecks ☑ None ☐ Other _____ **Turbidity (if not measured)** ☐ Clear ☐ Slightly turbid ☐ Turbid ☐ Opaque ☑ Stained tannin ☐ Other _____
SEDIMENT/ SUBSTRATE	**Odors** ☑ Normal ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Anaerobic ☐ None ☐ Other _____ **Oils** ☑ Absent ☐ Slight ☐ Moderate ☐ Profuse **Deposits** ☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand ☐ Relict shells ☑ Other Rat parts – cattails + fragmites **Looking at stones which are not deeply embedded, are the undersides black in color?** ☐ Yes ☐ No not present

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	Diameter	% Composition in Sampling Reach	Substrate Type	Characteristic	% Composition in Sampling Area
Bedrock			Detritus	sticks, wood, coarse plant materials (CPOM)	80%
Boulder	> 256 mm (10")				
Cobble	64-256 mm (2.5"-10")		Muck-Mud	black, very fine organic (FPOM)	20%
Gravel	2-64 mm (0.1"-2.5")				
Sand	0.06-2mm (gritty)	90	Marl	grey, shell fragments	
Silt	0.004-0.06 mm	10			
Clay	< 0.004 mm (slick)				

Weston Inc.

BARNEGAT BAY ENVIRONMENTAL TESTING
WETLAND SITE DATA

Location ID/Name: NWS01 **Date:** 22 MAY 2000
Photo Rolls/Frames: ROLL #1 (2 THROUGH 8) **Crew:** SPH, MP
Weather conditions: STEADY RAIN, COOL **Air Temp.:** 65°F

Sediment type(s) present: FINE SAND TO COARSE SAND THROUGHOUT

Size of fill, berms, water control structures, etc.: THE 2 MAIN BERMS ARE AVE OF 17 FEET WIDE BY 16 INCHES TO WATER SURFACE. SOME OF FILL EXTENDS BELOW H2O SURFACE TO ABOUT 3 FEET. WATER CONTROL STRUCTURE IS ABOUT 25 INCHES ABOVE LOWER POND LEVEL. PARTS OF THE SUB-BERMS ARE SUBMERGED.

Water Quality

Sampling Location	pH	Salinity (o/oo)	D.O. (mg/L)	Specific Conductivity (mS/cm)	Temp. (°C)	Turbidity (NTU)
W1	6.01	0.02	7.52	0.055	14.47	27.3
W2	5.13	0.03	7.88	0.053	14.47	27.6
W3 (IMMED. DOWNST.)	4.67	0.02	11.84	0.052	13.81	22.4
W4 (WAY DOWNST.)	4.60	0.03	10.11	0.046	13.64	19.3
W5 (UPSTREAM OF SITE)	4.95	0.02	9.38	0.050	12.11	26.7

Potential for fish passage? (Y/N (if yes, complete instream and riparian data sheets and attach) ✓

Wildlife observed: CANADA GOOSE, GC. FLYCATCHER

Potential impacts to existing systems: POTENTIAL FOR GREATER "FLASHINESS" (SLIGHT) AFTER BREACHING BERMS, UNTIL AWC WETLANDS ARE ESTABLISHED (I.E. DOWNSTREAM BRIDGE)

Potential conflicting adjacent land uses: NONE (LIGHT INDUSTRIAL, CHURCH, RESIDENCE)

Notes and sketches: BREACH ON N-MOST BERM IS 68 FT. ACROSS

Checklist
- ✓ re-evaluate restoration concepts
- ✓ map site boundaries
- ✓ map vegetation & land cover
- ✓ map on-site & adjacent wetlands
- ✓ assess up/downstream habitats

⇒ CREATE 4 OR 5 BREACHES IN EACH BERM (INCLUDING THE SMALL LATERAL ONES) TO HELP DRAIN POND & MAKE MORE CONDUCIVE FOR AWC

⇒ DO VOLUNTEER-BASED STREAM CLEANUP BELOW SITE? (TIRES, JUNK, ETC.)

BARNEGAT BAY ENVIRONMENTAL TESTING
WETLAND SITE DATA

Location ID/Name: NWS01 **Date:** 22 MAY 2000
Photo Rolls/Frames: _____ **Crew:** _____
Weather conditions: _____ **Air Temp.:** _____

Sediment type(s) present: _____

Size of fill, berms, water control structures, etc.: _____

Water Quality

Sampling Location	pH	Salinity (o/oo)	D.O. (mg/L)	Specific Conductivity (mS/cm)	Temp. (°C)	Turbidity (NTU)
1	[illegible]	0.02	[illegible]	0.055	14.47	[illegible]
	6.01		7.52	0.055		27.3
2	5.13	0.03	5.88	0.053	14.47	27.6
3 (DOWN)	4.67	0.02	10.84	0.052	13.81	22.4

Potential for fish passage? Y/N (if yes, complete instream and riparian data sheets and attach)

Wildlife observed: _____

Potential impacts to existing systems: _____

Potential conflicting adjacent land uses: _____

Notes and sketches:

BREACH #7 = 68 FT

DOWN = 1.6 FT. V = 0.85 F/S
WIDTH = 12.5
BRAIDED CHAN.

Checklist

- _ re-evaluate restoration concepts
- _ map site boundaries
- _ map vegetation & land cover
- _ map on-site & adjacent wetlands
- _ assess up/downstream habitats

Versar INC.

Barnegat Bay Environmental Site Testing
Habitat Assessment Field Data Sheet—Low Gradient Streams (Front)

STREAM NAME Cedar Run	LOCATION upstream NJ 581	
STATION # upstream NJ581	RIVER BASIN	
INVESTIGATORS M. Perot S. Harriott		
FORM COMPLETED BY M. Perot	DATE 5-22-00 TIME 1715 AM (PM)	REASON FOR SURVEY Barnegat Site Testing

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 18	20 19 (18) 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE 14	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE 16	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 18	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 20	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

NOTES:

lots of root wads + trees in water
no coarse substrate

lots of organic silt ontop of sand

Versar INC.

Barnegat Bay Environmental Site Testing
Habitat Assessment Field Data Sheet—Low Gradient Streams (Back)

STATION # upstream of NJ301	DATE 5-22-00

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 20	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line. <1-2 xs	Channel straight; waterway has been channelized for a long distance.
SCORE 11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 10 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 10 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

NOTES:

Some back channel

no signs of erosion

Powerline crosses stream - little impact noted

Total Score _____

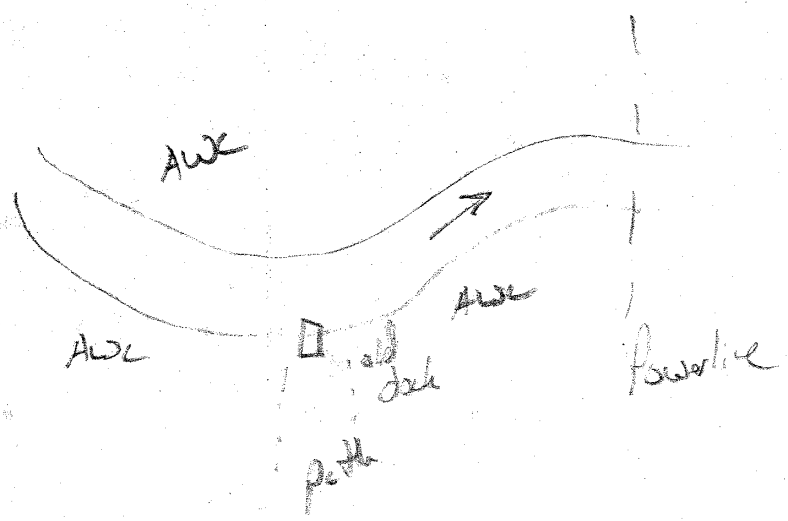
Barnegat Bay Environmental Site Testing
Physical Characterization/Water Quality Field Data Sheet
(Front)

STREAM NAME	LOCATION	
STATION #	RIVER BASIN	
INVESTIGATORS		
FORM COMPLETED BY	DATE _____ TIME _____ AM PM	REASON FOR SURVEY

WEATHER CONDITIONS	**Now**	**Past 24 hours**	**Has there been a heavy rain in the last 7 days?** ☐ Yes ☐ No unknown
	☐ storm (heavy rain)	☐	**Air Temperature**____°C 60°F
	☐ rain (steady rain)	☑	**Other**_____
	☑ showers (intermittent)	☐	
	10 %☑ %cloud cover	☑ 10 %	
	☐ clear/sunny	☐	

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)



STREAM CHARACTERIZATION	**Stream Subsystem** ☑ Perennial ☐ Intermittent ☐ Tidal	**Stream Type** ☑ Coldwater ☐ Warmwater
	Stream Origin ☐ Glacial ☐ Spring-fed ☐ Non-glacial montane ☐ Mixture of origins ☑ Swamp and bog ☐ Other_____	**Catchment Area**_____km²

Versar INC.

Barnegat Bay Environmental Site Testing
Physical Characterization/Water Quality Field Data Sheet (Back)

STATION #	DATE

WATERSHED FEATURES

Predominant Surrounding Landuse
☑ Forest ☐ Commercial
☐ Field/Pasture ☐ Industrial
☐ Agricultural ☐ Other _____
☐ Residential

Local Watershed NPS Pollution
☐ No evidence ☑ Some potential sources
☐ Obvious sources

Local Watershed Erosion
☑ None ☐ Moderate ☐ Heavy

powerline

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☑ Trees ☐ Shrubs ☐ Grasses ☐ Herbaceous

dominant species present Acer, high bush blueberry

INSTREAM FEATURES

Estimated Reach Length 300 ~~m~~ ft

Estimated Stream Width 38 ft ~~m~~

Sampling Reach Area _____ m²

Area in km² (m²x1000) _____ km²

Estimated Stream Depth 3.7 ft ~~m~~

Surface Velocity (at thalweg) 0.069 ~~m/sec~~ ft/sec
5 ft/1.2 min

Canopy Cover
☑ Partly open ☐ Partly shaded ☐ Shaded

High Water Mark _____ m

Proportion of Reach Represented by Stream Morphology Types
☐ Riffle _____ % ☐ Run _____ %
☐ Pool _____ %

Channelized ☐ Yes ☑ No

Dam Present ☑ Yes ☐ No downstream

LARGE WOODY DEBRIS

LWD _____ m²

Density of LWD _____ m²/km² (LWD/ reach area)

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present
☐ Rooted emergent ☑ Rooted submergent ☐ Rooted floating ☐ Free floating
☐ Floating Algae ☐ Attached Algae

dominant species present Pota magetan

Portion of the reach with aquatic vegetation 5 %

WATER QUALITY

Temperature 12.11 °C

Specific Conductance 0.050 mS/cm

Dissolved Oxygen 9.38 mg/L

pH 4.95

Turbidity 26.7 NTU

WQ Instrument Used YSI

SALINITY 0.03

Water Odors
☑ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other _____

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☑ None ☐ Other _____

Turbidity (if not measured)
☐ Clear ☐ Slightly turbid ☐ Turbid
☐ Opaque ☑ Stained tannin ☐ Other _____

SEDIMENT/ SUBSTRATE

Odors
☑ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other _____

Oils
☑ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☑ Other organic debris FAM

Looking at stones which are not deeply embedded, are the undersides black in color?
☐ Yes ☐ No no stones

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	Diameter	% Composition in Sampling Reach	Substrate Type	Characteristic	% Composition in Sampling Area
Bedrock			Detritus	sticks, wood, coarse plant materials (CPOM)	20%
Boulder	> 256 mm (10")				
Cobble	64-256 mm (2.5"-10")		Muck-Mud	black, very fine organic (FPOM)	80%
Gravel	2-64 mm (0.1"-2.5")				
Sand	0.06-2mm (gritty)	20%	Marl	grey, shell fragments	—
Silt	0.004-0.06 mm	80%			
Clay	< 0.004 mm (slick)				

Versar INC.

Barnegat Bay Environmental Site Testing
Habitat Assessment Field Data Sheet—Low Gradient Streams (Front)

STREAM NAME Cedar Run	LOCATION downstream of NWS01	
STATION # NWS01	RIVER BASIN	
INVESTIGATORS M. Perot, S. Harriott		
FORM COMPLETED BY M. Perot	DATE 5-22-00 TIME 15:00 AM (PM)	REASON FOR SURVEY Barnegat Site Testing

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 (17) 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	(15) 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 (17) 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 (18) 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 (19) 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

NOTES:

Sandy bottom in places but lots of leaf packs + woody debris

Some veg some deposition in pools

- many logjams + clusters of LWD in channel - provide lots of habitat + cover
- stream channel is complex, with water draining through banks into back channels or draining into distributary side channels - large trees + shrubs have stabilized channels
- banks are very stable, but many small branches (≤4" diameter) have fallen into water + become tangled together.
- lots of trash observed downstream of ATG bridge - tires, buckets, wood, metal - probably from roadside dumping + washed downstream. Potential for streamwalk to clean up stream w/ volunteer help.

Versar INC.

Barnegat Bay Environmental Site Testing
Habitat Assessment Field Data Sheet—Low Gradient Streams (Back)

STATION # downstream NW50K	DATE 5-22-00

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	(15) 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 (18) 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 (9)	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 (9)	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 (9)	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 (9)	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank (10) 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank (10) 9	8 7 6	5 4 3	2 1 0

NOTES:

RT 9 bridge upstream w/ old cranberry bog

anastomosing channel

undisturbed veg.

lots of trash in & along channel - washed down from RT 9 bridge tires, plastic metal, wood

Total Score _____

Versar INC.

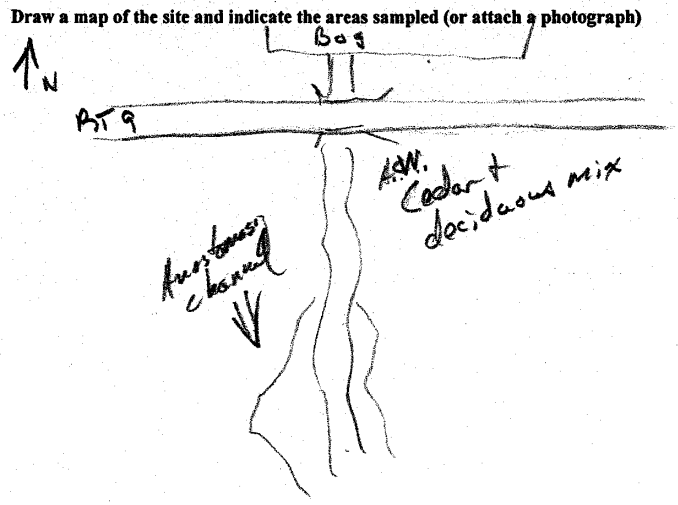
Barnegat Bay Environmental Site Testing
Physical Characterization/Water Quality Field Data Sheet
(Front)

STREAM NAME Cedar Run	LOCATION downstream from NWS01	
STATION # downstream NWS01	RIVER BASIN	
INVESTIGATORS M. Perot, S. Harriott		
FORM COMPLETED BY M. Perot	DATE 5-22-00 TIME 15:00 AM (PM)	REASON FOR SURVEY Barnegat Site Testing

WEATHER CONDITIONS	**Now**	**Past 24 hours**	**Has there been a heavy rain in the last 7 days?** ☐ Yes ☐ No unknown
	☐ storm (heavy rain)	☐	
	☑ rain (steady rain)	☑	**Air Temperature** 20 °C
	☐ showers (intermittent)	☑	
	100 % ☑ %cloud cover	☑ 90+ %	**Other**_____
	☐ clear/sunny	☐	

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)



STREAM CHARACTERIZATION

Stream Subsystem
☑ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☑ Coldwater ☐ Warmwater

Stream Origin
☐ Glacial ☐ Spring-fed
☐ Non-glacial montane ☐ Mixture of origins
☑ Swamp and bog ☐ Other_____

Catchment Area_____km²

Versar INC.

Barnegat Bay Environmental Site Testing
Physical Characterization/Water Quality Field Data Sheet (Back)

STATION # downstream of NJ501	DATE 5-22-00

WATERSHED FEATURES	**Predominant Surrounding Landuse** ☑ Forest ☐ Commercial ☐ Field/Pasture ☐ Industrial ☐ Agricultural ☐ Other _____ ☐ Residential **Local Watershed NPS Pollution** ☐ No evidence ☑ Some potential sources ☐ Obvious sources **Local Watershed Erosion** ☑ None ☐ Moderate ☐ Heavy
RIPARIAN VEGETATION (18 meter buffer)	**Indicate the dominant type and record the dominant species present** ☑ Trees ☐ Shrubs ☐ Grasses ☐ Herbaceous **dominant species present** Atlantic White Cedar, Red Maple, Sweet pepperbush, highbush blueberry
INSTREAM FEATURES	**Estimated Reach Length** 300' ~~m~~ **Estimated Stream Width** 15' ~~m~~ **Sampling Reach Area** 4500 ~~m²~~ ft² **Area in km² (m²x1000)** _____ km² **Estimated Stream Depth** 1.6' ~~m~~ **Surface Velocity (at thalweg)** 1.1 ft/sec ~~m/sec~~ 10 ft / 8.5 sec 300/15 1500 / 1500 3000 / 45 00 **Canopy Cover** ☐ Partly open ☐ Partly shaded ☑ Shaded **High Water Mark** 5 ft ~~m~~ **Proportion of Reach Represented by Stream Morphology Types** ☐ Riffle 10 % ☐ Run 60 % ☐ Pool 30 % **Channelized** ☑ Yes ☐ No beneath RT9 **Dam Present** ☑ Yes ☐ No upstream at bay
LARGE WOODY DEBRIS	**LWD** _____ m² **Density of LWD** _____ m²/km² (LWD/ reach area)
AQUATIC VEGETATION	**Indicate the dominant type and record the dominant species present** ☐ Rooted emergent ☑ Rooted submergent ☐ Rooted floating ☐ Free floating ☐ Floating Algae ☐ Attached Algae **dominant species present** _____ **Portion of the reach with aquatic vegetation** 10 %
WATER QUALITY W3	**Temperature** 13.81 °C **Specific Conductance** 0.052 mS/cm **Dissolved Oxygen** 11.84 mg/L **pH** 4.67 **Turbidity** 22.4 NTU **WQ Instrument Used** YSI Salinity 0.02 **Water Odors** ☐ Normal/None ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Fishy ☑ Other Sulfurous **Water Surface Oils** ☐ Slick ☐ Sheen ☐ Globs ☐ Flecks ☑ None ☐ Other _____ **Turbidity (if not measured)** ☐ Clear ☐ Slightly turbid ☐ Turbid ☐ Opaque ☑ Stained tanish ☐ Other _____
SEDIMENT/ SUBSTRATE	**Odors** ☐ Normal ☐ Sewage ☐ Petroleum ☐ Chemical ☑ Anaerobic ☐ None ☐ Other _____ **Oil** ☑ Absent ☐ Slight ☐ Moderate ☐ Profuse **Deposits** ☐ Sludge ☐ Sawdust ☐ Paper fiber ☑ Sand ☐ Relict shells ☐ Other _____ **Looking at stones which are not deeply embedded, are the undersides black in color?** ☐ Yes ☐ No stones not present

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**	**Substrate Type**	**Characteristic**	**% Composition in Sampling Area**
Bedrock			Detritus	sticks, wood, coarse plant materials (CPOM)	70%
Boulder	> 256 mm (10")				
Cobble	64-256 mm (2.5"-10")		Muck-Mud	black, very fine organic (FPOM)	5%
Gravel	2-64 mm (0.1"-2.5")	5%			
Sand	0.06-2mm (gritty)	90%	Marl	grey, shell fragments	-
Silt	0.004-0.06 mm	2.5			
Clay	< 0.004 mm (slick)	2.5			

Wetlands Inc.

BARNEGAT BAY ENVIRONMENTAL TESTING
WETLAND SITE DATA

Location ID/Name: NW503 **Date:** 15 JUNE
Photo Rolls/Frames: DCP#5 **Crew:** SPH & KD
Weather conditions: SUNNY **Air Temp.:** 78°F

Sediment type(s) present: N/A

Size of fill, berms, water control structures, etc.: SEE DRAWING ON HABITAT ASSESS SHEET & DRAWING ON SS FIELD SHEET

Water Quality

Sampling Location	pH	Salinity (o/oo)	D.O. (mg/L)	Specific Conductivity (mS/cm)	Temp. (°C)	Turbidity (NTU)	
W1 (Immed. upst. of structure)	5.13	0.02	8.80	0.038	18.59	20.4	(DEPTH = 1.5 FT.)
W2 (≈ 200 FT. Below structure)	4.42	0.02	8.73	0.038	19.59	21.2	(DEPTH = 0.712 FT)

Potential for fish passage? Y/N (if yes, complete instream and riparian data sheets and attach)

Wildlife observed: LOCAL ANGLER INDICATED THAT THERE ARE LARGE GRASS PIKE IN THE REACH IMMEDIATELY ABOVE STRUCTURE. HE ALSO SAID THEY CATCH MANY CATFISH IN THE DEEP HOLE IMMED. BELOW STRUCTURE. SAID HE SAW "ROCK BASS" RECENTLY RIGHT ABOVE THE STRUCTURE.

Potential impacts to existing systems: THE DEEP HOLE RIGHT BELOW THE STRUCTURE IS THE LOCAL SWIMMING HOLE. THE LOCALS MAY BE SENSITIVE ABOUT LOSING THIS. COULD WE DESIGN SOME AMENITIES FOR LOCAL SWIMMERS? ALSO, ADJACENT RESIDENT RAISES DUCKS + THEY SEEM TO USE THE REACH

Potential conflicting adjacent land uses: NONE

Notes and sketches: SON OF ADJACENT RESIDENT (AN ADULT) CONFIRMED THAT THEY OWN ONLY THE FIRST PART OF THE ACCESS TO THE STRUCTURE. APPARENTLY THE STATE OWNS THE STRUCTURE ITSELF (WE SAID IT WAS PRIVATELY OWNED IN SS REPORT).

Checklist

- ✓ re-evaluate restoration concepts
- ✓ map site boundaries
- ✓ map vegetation & land cover
- ✓ map on-site & adjacent wetlands
- ✓ assess up/downstream habitats

SPP. IN AWC	SPP. IN MIXED DECID. FOREST (WET)
AWC	BLACK GUM
RED MAPLE	RED MAPLE
CLETHRA	AWC
HB BLUEB.	CLETHRA
	H.B. BLUEB.

Versar INC.

Barnegat Bay Environmental Site Testing
Habitat Assessment Field Data Sheet—Low Gradient Streams (Front)

STREAM NAME WEST SKUNK CK.	LOCATION NW503 (IMMED. UPSTREAM)	
STATION # 1	RIVER BASIN	
INVESTIGATORS SPH/KD		
FORM COMPLETED BY SPH	DATE 15 JUNE 2000 TIME 2:00 AM (PM)	REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 (13) 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 (14) 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 (11)	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 (18) 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

NOTES:

*- LOTS OF Green Algae

BUGS:
CADDIS Fly
(ON WOOD DEBRIS)

Concrete wall End to End
→ 63 FT., 5 INCHES

WIDTH OF STRUCT. VARIES FROM ABO 10 FEET (FOOTPATH H ROAD) TO 20 FEET (IN THE 2 WIDE PARTS IS ≤ 10 FT. TALL

Right End of Concrete wall to Road
→ 38 ft

[TOTAL WIDTH = 101 FT., 5 INCHES]

Page 1 of 2

Barnegat Bay Environmental Site Testing
Habitat Assessment Field Data Sheet—Low Gradient Streams (Back)

STATION #	DATE

NOTES:

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 (13) 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 (6)	5 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 9 (LB)	Left Bank 10 (9)	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 (9)	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 9 (LB)	Left Bank 10 (9)	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 (9)	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 7 (LB)	Left Bank 10 9	8 (7) 6	5 4 3	2 1 0
SCORE 5 (RB)	Right Bank 10 9	8 7 6	(5) 4 3	2 1 0

Total Score _____

Barnegat Bay Environmental Site Testing
Physical Characterization/Water Quality Field Data Sheet
(Front)

STREAM NAME	LOCATION	
STATION #	RIVER BASIN	
INVESTIGATORS		
FORM COMPLETED BY	DATE _____ TIME _____ AM PM	REASON FOR SURVEY

WEATHER CONDITIONS

Now		Past 24 hours
☐	storm (heavy rain)	☐
☐	rain (steady rain)	☐
☐	showers (intermittent)	☒
40 % ☐	%cloud cover	☐ ___ %
☒	clear/sunny	☐

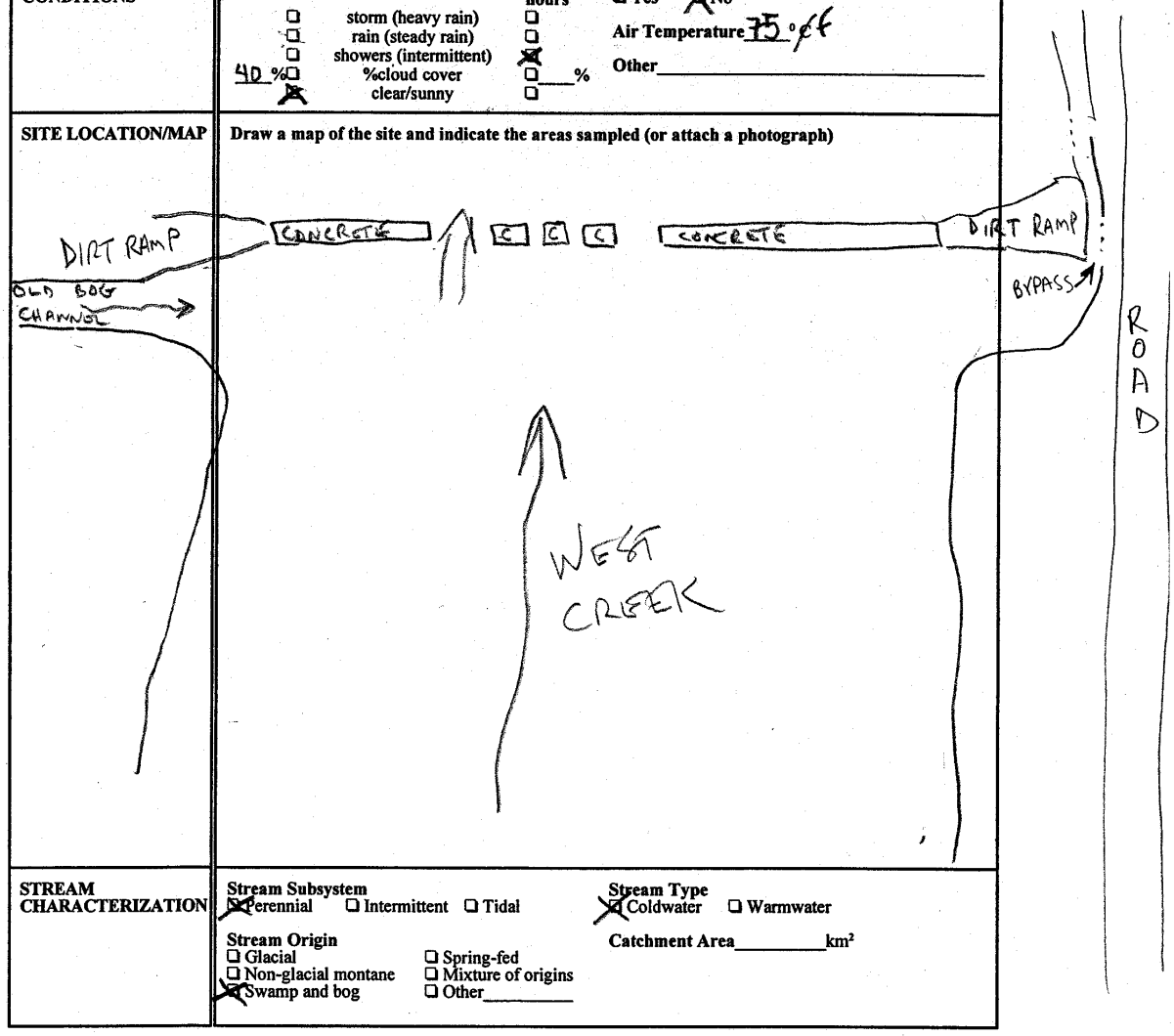
Has there been a heavy rain in the last 7 days? ☐ Yes ☒ No

Air Temperature 75 °F

Other_____

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)



STREAM CHARACTERIZATION

Stream Subsystem
☒ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☒ Coldwater ☐ Warmwater

Stream Origin
☐ Glacial ☐ Spring-fed
☐ Non-glacial montane ☐ Mixture of origins
☒ Swamp and bog ☐ Other_____

Catchment Area_____km²

Versar INC.

Barnegat Bay Environmental Site Testing
Physical Characterization/Water Quality Field Data Sheet (Back)

STATION #	DATE

WATERSHED FEATURES	**Predominant Surrounding Landuse** ☒ Forest ☐ Commercial ☐ Field/Pasture ☐ Industrial ☐ Agricultural ☒ Other DOMESTIC DUCK USE ☐ Residential **Local Watershed NPS Pollution** ☒ No evidence ☐ Some potential sources ☐ Obvious sources **Local Watershed Erosion** ☒ None ☐ Moderate ☐ Heavy
RIPARIAN VEGETATION (18 meter buffer)	**Indicate the dominant type and record the dominant species present** ☒ Trees ☐ Shrubs ☐ Grasses ☐ Herbaceous **dominant species present** AWC, SW. PORPOISEWEED, RED MAPLE
INSTREAM FEATURES	**Estimated Reach Length** 300FT ~~m~~ **~~Estimated~~ Stream Width** 63FT ~~m~~ **Sampling Reach Area** _____ m² **Area in km² (m²x1000)** _____ km² **~~Estimated~~ Stream Depth** 1FT 9" ~~m~~ **Surface Velocity (at thalweg)** _____ ~~m/sec~~ 10FT IN 15SEC. **Canopy Cover** ☒ Partly open ☒ Partly shaded ☐ Shaded **High Water Mark** N/A m **Proportion of Reach Represented by Stream Morphology Types** ☐ Riffle 0 % ☐ Run 93 % ☐ Pool 7 % **Channelized** ☐ Yes ☒ No **Dam Present** ☒ Yes ☐ No
LARGE WOODY DEBRIS	**LWD** _____ m² **Density of LWD** _____ m²/km² (LWD/ reach area) N/A
AQUATIC VEGETATION	**Indicate the dominant type and record the dominant species present** ☐ Rooted emergent ☒ Rooted submergent ☒ Rooted floating ☐ Free floating ☐ Floating Algae ☐ Attached Algae **dominant species present** RUPPIA SP., WATER LILLY **Portion of the reach with aquatic vegetation** 75 %
WATER QUALITY SEE DATA SHEET	**Temperature** _____ °C **Specific Conductance** _____ mS/cm **Dissolved Oxygen** _____ mg/L **pH** _____ **Turbidity** _____ NTU **WQ Instrument Used** _____ **Water Odors** ☐ Normal/None ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Fishy ☐ Other_____ **Water Surface Oils** ☐ Slick ☐ Sheen ☐ Globs ☐ Flecks ☐ None ☐ Other_____ **Turbidity (if not measured)** ☐ Clear ☐ Slightly turbid ☐ Turbid ☐ Opaque ☐ Stained ☐ Other_____
SEDIMENT/ SUBSTRATE	**Odors** ☐ Normal ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Anaerobic ☒ None ☐ Other_____ **Oils** NONE ☐ Absent ☐ Slight ☐ Moderate ☐ Profuse **Deposits** NONE ☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand ☐ Relict shells ☐ Other_____ **Looking at stones which are not deeply embedded, are the undersides black in color?** ☐ Yes ☐ No NO STONES (LOTS OF SILT/SAND)

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**	**Substrate Type**	**Characteristic**	**% Composition in Sampling Area**
Bedrock			Detritus	sticks, wood, coarse plant materials (CPOM)	50
Boulder	> 256 mm (10")				
Cobble	64-256 mm (2.5"-10")		Muck-Mud	black, very fine organic (FPOM)	20
Gravel	2-64 mm (0.1"-2.5")	10			
Sand	0.06-2mm (gritty)	60	Marl	grey, shell fragments	NONE
Silt	0.004-0.06 mm	30			
Clay	< 0.004 mm (slick)				

Versar INC.

Barnegat Bay Environmental Site Testing
Habitat Assessment Field Data Sheet—Low Gradient Streams (Front)

STREAM NAME WEST CK.	LOCATION NW503 (IMMED. DOWNSTREAM)	
STATION # 2	RIVER BASIN	
INVESTIGATORS KD/SPH		
FORM COMPLETED BY SPH	DATE 15 JUNE 2000 TIME 3:20 AM (PM)	REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 (16)	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 13 12 (11)	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 (13) 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 (9) 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 (16)	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

NOTES:

=> MUCH MORE GRAVEL & COBBLE SUBSTRATE HERE BELOW THE DEEP POOL AREA IMMEDIATELY BELOW THE STRUCTURE.

Barnegat Bay Environmental Site Testing
Habitat Assessment Field Data Sheet—Low Gradient Streams (Back)

STATION #	DATE

NOTES:

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score _____

Barnegat Bay Environmental Site Testing
Physical Characterization/Water Quality Field Data Sheet
(Front)

STREAM NAME	LOCATION	
STATION #	RIVER BASIN	
INVESTIGATORS		
FORM COMPLETED BY	DATE _____ TIME _____ AM PM	REASON FOR SURVEY

WEATHER CONDITIONS

Now		Past 24 hours
☐	storm (heavy rain)	☐
☐	rain (steady rain)	☐
☒	showers (intermittent)	☒
0 % ☐	%cloud cover	☐ ___ %
☒	clear/sunny	☐

Has there been a heavy rain in the last 7 days? ☒ Yes ☐ No

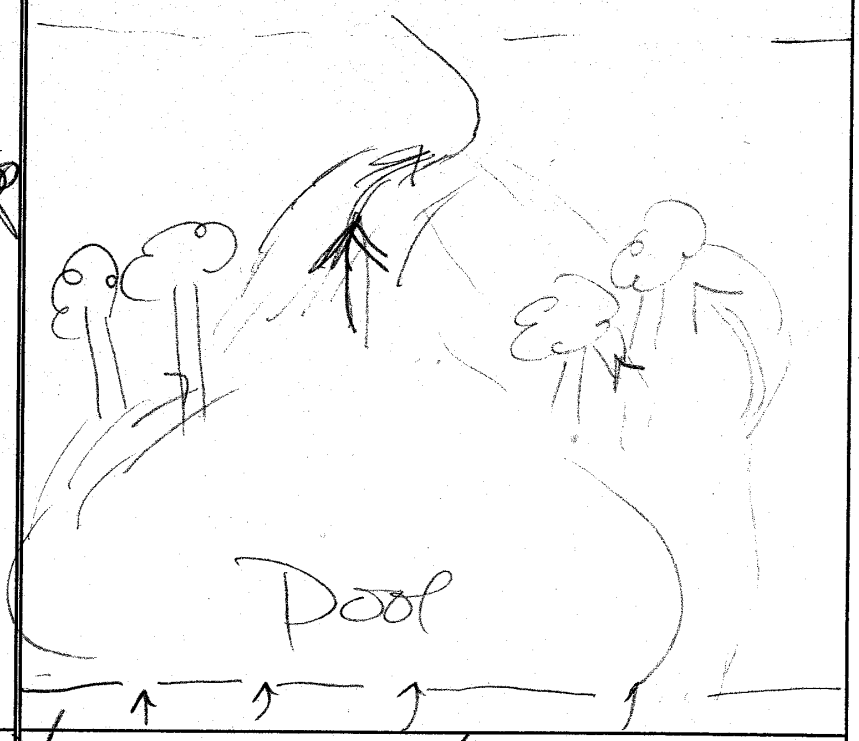
Air Temperature 75 °C

Other_____

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)

Lots of tree clumps



STREAM CHARACTERIZATION

Stream Subsystem
☒ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☒ Coldwater ☐ Warmwater

Stream Origin
☒ Glacial
☒ Non-glacial montane
☒ Swamp and bog
☐ Spring-fed
☐ Mixture of origins
☐ Other_____

Catchment Area_____km²

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Barnegat Bay Environmental Site Testing
Physical Characterization/Water Quality Field Data Sheet (Back)

STATION #	DATE

WATERSHED FEATURES

Predominant Surrounding Landuse
☒ Forest ☐ Commercial
☐ Field/Pasture ☐ Industrial
☐ Agricultural ☐ Other DUCKS
☐ Residential

Local Watershed NPS Pollution
☒ No evidence ☐ Some potential sources
☐ Obvious sources

Local Watershed Erosion
☐ None ☒ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☒ Trees ☐ Shrubs ☐ Grasses ☐ Herbaceous

dominant species present AW, RBM, Sweet pepperbush, Black Gum

INSTREAM FEATURES

Estimated Reach Length 300 FT ~~m~~

Estimated Stream Width 18 FT 3 IN ~~m~~

Sampling Reach Area _____ m²

Area in km² (m²x1000) _____ km²

Estimated Stream Depth 18 IN ~~m~~

Surface Velocity (at thalweg) _____ m/sec
10 FT IN 4 SEC.

Canopy Cover → more shade
☐ Partly open ☒ Partly shaded ☐ Shaded

High Water Mark 1 m

Proportion of Reach Represented by Stream Morphology Types
☒ Riffle 70 % ☒ Run 10 %
☒ Pool 20 %

Channelized ☒ Yes ☐ No

Dam Present ☒ Yes ☐ No

LARGE WOODY DEBRIS

LWD _____ m²

Density of LWD _____ m²/km² (LWD/ reach area) LOTS

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present NONE
☐ Rooted emergent ☐ Rooted submergent ☐ Rooted floating ☐ Free floating
☐ Floating Algae ☐ Attached Algae

dominant species present _____

Portion of the reach with aquatic vegetation 0 %

WATER QUALITY

See data sheet

Temperature _____ °C

Specific Conductance _____ mS/cm

Dissolved Oxygen _____ mg/L

pH _____

Turbidity _____ NTU

WQ Instrument Used _____

Water Odors
☒ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other_____

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☒ None ☐ Other_____

Turbidity (if not measured)
☒ Clear ☐ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other_____

SEDIMENT/ SUBSTRATE

Odors
☐ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☒ None
☐ Other_____

Oils
☒ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits None
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other_____

Looking at stones which are not deeply embedded, are the undersides black in color?
☐ Yes ☒ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	Diameter	% Composition in Sampling Reach	Substrate Type	Characteristic	% Composition in Sampling Area
Bedrock			Detritus	sticks, wood, coarse plant materials (CPOM)	50
Boulder	> 256 mm (10")				
Cobble	64-256 mm (2.5"-10")	5	Muck-Mud	black, very fine organic (FPOM)	10
Gravel	2-64 mm (0.1"-2.5")	60			
Sand	0.06-2mm (gritty)	20	Marl	grey, shell fragments	0
Silt	0.004-0.06 mm	15			
Clay	< 0.004 mm (slick)				

Weston Inc.

(1)

BARNEGAT BAY ENVIRONMENTAL TESTING
WETLAND SITE DATA

Location ID/Name: NJNS02 / STAFFORD FORGE
Date: 24 MAY 2000
Photo Rolls/Frames: #2 AND #3
Crew: SPH & MP
Weather conditions: SUNNY/P. CLOUDY
Air Temp.: 75° F

Sediment type(s) present: _____

Size of fill, berms, water control structures, etc.: SEE NOTES BELOW
*- NOTE POND NUMBERING SYSTEM NORTH TO SOUTH (& SMALLEST POND NOT NUMBERED)

Water Quality

Sampling Location	pH	Salinity (o/oo)	D.O. (mg/L)	Specific Conductivity (mS/cm)	Temp. (°C)	Turbidity (NTU)
W1 (GOVERNOR'S BRANCH)	4.21	0.01	9.81	0.034	14.14	18.8
W2 (HEADWATERS - SEE MAP ON WOODSCOMB GAZETTEER)	3.77	0.02	8.48	0.045	13.85	18.2
W3 (ON-STREAM, BELOW TOP POND - SEE MAP)	4.22	0.01	9.68	0.030	14.71	18.50
W4 (UPPER POND SE CORNER)	4.92	0.02	8.61	0.036	22.30	20.4
W5 (POND #2 SW EDGE)	4.65	0.01	10.42	0.035	21.37	20.3

Potential for fish passage? Y/N (if yes, complete instream and riparian data sheets and attach)

Wildlife observed: AM. EGRET, SNOWY EGRET, BROWN THRASHER, PRAIRIE WARB, PINE WARB, MALLARD, BLACK BUCK, W.E. VIREO, RS TOWHEE, HOUSE WREN, PAINTED TURTLE, MUD TURTLE, (BOG TURTLE)

Potential impacts to existing systems: _____

Potential conflicting adjacent land uses: _____

Notes and sketches:

* W3 = 9 FT FROM TOP OF BERM TO WATER LEVEL

* BERM @ POND #1 (BIG TRIANGLE) = 7 FT TO WATER LEVEL & IS ≈ 40 FT. WIDE (N SIDE)
4 FT. TO WATER LEVEL & 37 FT WIDE ON S SIDE

* - BERM BETWEEN SECOND & THIRD PONDS (WEST SIDE) = 40 FT WIDE BY 7 FT. TO WATE

* - BERM BETWEEN THIRD & FOURTH POND = 65 FT x 10 FT.

Checklist

- ✓ re-evaluate restoration concepts
- ✓ map site boundaries
- ✓ map vegetation & land cover
- ✓ map on-site & adjacent wetlands
- ✓ assess up/downstream habitats

Versar INC.

(2)

BARNEGAT BAY ENVIRONMENTAL TESTING
WETLAND SITE DATA

Location ID/Name: NW502/STAFFORD FORGE **Date:** 24 Mar 2000
Photo Rolls/Frames: _____ **Crew:** SPH/MP
Weather conditions: _____ **Air Temp.:** 78°F

Sediment type(s) present: _____

Size of fill, berms, water control structures, etc.: _____

Water Quality

Sampling Location	pH	Salinity (o/oo)	D.O. (mg/L)	Specific Conductivity (mS/cm)	Temp. (°C)	Turbidity (NTU)
W6 (POND #3 SW EDGE)	4.73	0.02	10.51	0.037	22.05	18.0
W7 (WESTFLUNE CREEK AT LARGE BRANCH)	4.85	0.01	8.89	0.030	22.65	19.3
W8 (DOWNSTREAM BELOW MAIN STRUCTURE)	4.55	0.01	9.84	0.029	22.36	18.7

Potential for fish passage? Y/N (if yes, complete instream and riparian data sheets and attach)

Wildlife observed: CATBIRD

Potential impacts to existing systems: _____

Potential conflicting adjacent land uses: _____

Notes and sketches:

30 FT WIDE
33" MAX DEPTH
10 FT/8 SEC

Checklist

- _ re-evaluate restoration concepts
- _ map site boundaries
- _ map vegetation & land cover
- _ map on-site & adjacent wetlands
- _ assess up/downstream habitats

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Barnegat Bay Environmental Site Testing
Habitat Assessment Field Data Sheet—Low Gradient Streams (Front)

STREAM NAME WESTECUNK CREEK	LOCATION HEADWATERS	
STATION # 1	RIVER BASIN	
INVESTIGATORS MPG SPH		
FORM COMPLETED BY SPH	DATE 24 MAY 2000 TIME 10:30 AM PM	REASON FOR SURVEY ENVIRONMENTAL TESTING

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

NOTES:

- HEAVY ALGAE COVER (GREEN FILAMENTOUS)
- INVOLVES:
  - WATER STRIDERS
  - AQUATIC BEETLES

Versar INC.

Barnegat Bay Environmental Site Testing
Habitat Assessment Field Data Sheet—Low Gradient Streams (Back)

STATION # 1 /HEADWATERS WEST FORK	DATE 24 MAY 2000

NOTES:

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 (19) 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	(15) 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 10 (LB)	Left Bank (10) 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank (10) 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 10 (LB)	Left Bank (10) 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank (10) 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 10 (LB)	Left Bank (10) 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank (10) 9	8 7 6	5 4 3	2 1 0

Total Score _____

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Barnegat Bay Environmental Site Testing
Physical Characterization/Water Quality Field Data Sheet
(Front)

STREAM NAME WATCHUNK CREEK	LOCATION #1	
STATION #	RIVER BASIN	
INVESTIGATORS		
FORM COMPLETED BY	DATE _____ TIME _____ AM PM	REASON FOR SURVEY

WEATHER CONDITIONS

Now		Past 24 hours
☐	storm (heavy rain)	☒
☐	rain (steady rain)	☐
☐	showers (intermittent)	☐
___% ☐	%cloud cover	☐ ___%
☒	clear/sunny	☐

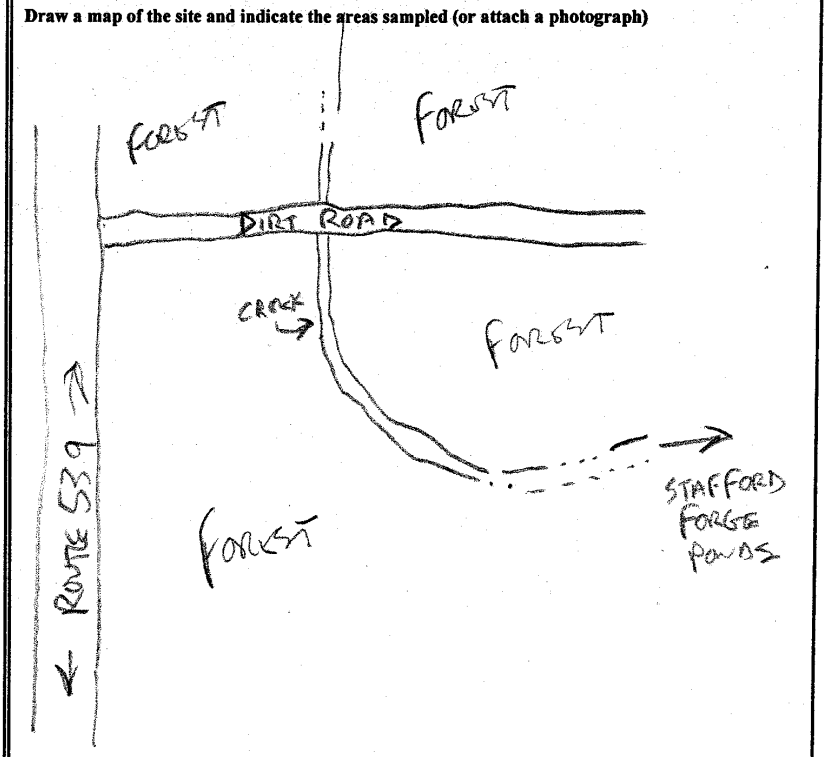
Has there been a heavy rain in the last 7 days? ☒ Yes ☐ No

Air Temperature 75 °C/F

Other _____

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)



STREAM CHARACTERIZATION

Stream Subsystem: ☒ Perennial ☐ Intermittent ☐ Tidal

Stream Type: ☒ Coldwater ☐ Warmwater

Stream Origin:
- ☐ Glacial
- ☐ Non-glacial montane
- ☒ Swamp and bog
- ☐ Spring-fed
- ☐ Mixture of origins
- ☐ Other_____

Catchment Area_____km²

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Barnegat Bay Environmental Site Testing
Physical Characterization/Water Quality Field Data Sheet (Back)

STATION # 1	DATE 24 MAY 2000

WATERSHED FEATURES	**Predominant Surrounding Landuse** ☒ Forest ☐ Commercial ☐ Field/Pasture ☐ Industrial ☐ Agricultural ☐ Other _____ ☐ Residential **Local Watershed NPS Pollution** ☒ No evidence ☐ Some potential sources ☐ Obvious sources **Local Watershed Erosion** ☒ None ☐ Moderate ☐ Heavy
RIPARIAN VEGETATION (18 meter buffer)	**Indicate the dominant type and record the dominant species present** ☒ Trees ☐ Shrubs ☐ Grasses ☐ Herbaceous **dominant species present** AWC, CLETHRA, RED MAPLE
INSTREAM FEATURES	**Estimated Reach Length** 300 m/FT. **Estimated Stream Width** 12 m FT. **Sampling Reach Area** _____ m² **Area in km² (m²x1000)** _____ km² **Estimated Stream Depth** 33 cm IN **Surface Velocity (at thalweg)** _____ m/sec 10 FT/8SEC. **Canopy Cover** ☐ Partly open ☒ Partly shaded ☐ Shaded **High Water Mark** N/A m **Proportion of Reach Represented by Stream Morphology Types** ☒ Riffle 0 % ☒ Run 90 % ☒ Pool 10 % **Channelized** ☐ Yes ☒ No **Dam Present** ☒ Yes ☐ No → DOWNSTREAM
LARGE WOODY DEBRIS	**LWD** _____ m² **Density of LWD** _____ m²/km² (LWD/ reach area)
AQUATIC VEGETATION	**Indicate the dominant type and record the dominant species present** ☐ Rooted emergent ☒ Rooted submergent ☐ Rooted floating ☐ Free floating ☐ Floating Algae ☒ Attached Algae **dominant species present** FILAMENTOUS GREEN + POTAMAGETON **Portion of the reach with aquatic vegetation** _____ % * - ALGAE VERY THICK + HEAVY
WATER QUALITY SEE DATA SHEET W2	**Temperature** _____ °C **Specific Conductance** _____ mS/cm **Dissolved Oxygen** _____ mg/L **pH** _____ **Turbidity** _____ NTU **WQ Instrument Used** _____ **Water Odors** ☒ Normal/None ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Fishy ☐ Other _____ **Water Surface Oils** ☐ Slick ☐ Sheen ☐ Globs ☐ Flecks ☒ None ☐ Other _____ **Turbidity (if not measured)** ☐ Clear ☐ Slightly turbid ☐ Turbid ☐ Opaque ☐ Stained ☒ Other TANINS
SEDIMENT/ SUBSTRATE	**Odors** ☐ Normal ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Anaerobic ☒ None ☐ Other _____ **Oils** N/A ☐ Absent ☐ Slight ☐ Moderate ☐ Profuse **Deposits** N/A ☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand ☐ Relict shells ☐ Other _____ **Looking at stones which are not deeply embedded, are the undersides black in color?** ☐ Yes ☒ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**	**Substrate Type**	**Characteristic**	**% Composition in Sampling Area**
Bedrock			Detritus	sticks, wood, coarse plant materials (CPOM)	20%
Boulder	> 256 mm (10")				
Cobble	64-256 mm (2.5"-10")		Muck-Mud	black, very fine organic (FPOM)	80%
Gravel	2-64 mm (0.1"-2.5")	5%			
Sand	0.06-2mm (gritty)	80%	Marl	grey, shell fragments	0
Silt	0.004-0.06 mm	15%			
Clay	< 0.004 mm (slick)				

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Barnegat Bay Environmental Site Testing

Habitat Assessment Field Data Sheet—Low Gradient Streams (Front)

STREAM NAME Westecunk Creek	LOCATION downstream of dam at Stafford Forge - upstream of GSPaRkway bridge	
STATION # downstream NWSC2	RIVER BASIN	
INVESTIGATORS M. Reid, S. Hewitt		
FORM COMPLETED BY M. Reid	DATE 5-24-00 TIME 1640 AM (PM)	REASON FOR SURVEY Barnegat Site Testing

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 16	20 19 18 17 (16)	(15) 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE 19	20 (19) 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE 17	20 19 18 (17) 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 17	20 19 18 (17) 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 20	(20) 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

NOTES:

Several undercut banks, some large w/ debris

little change in lateral stream margins - some deposition of sand/gravel material, possibly from road or grade adjustment

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Barnegat Bay Environmental Site Testing
Habitat Assessment Field Data Sheet—Low Gradient Streams (Back)

STATION # downstream of NW502	DATE 5-24-00

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 15	20 19 18 17 16	(15) 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line. (less than	Channel straight; waterway has been channelized for a long distance.
SCORE 8	20 19 18 17 16	15 14 13 12 11	10 9 (8) 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 10 (LB)	Left Bank (10) 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 (9)	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 10 (LB)	Left Bank (10) 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank (10) 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 8 (LB)	Left Bank 10 9	(8) 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank (10) 9	8 7 6	5 4 3	2 1 0

NOTES:

Stream exits impoundment + passes beneath road - crosses beneath GSP 3 150m downstream of impoundment

Rt. bank has footpaths created by anglers

Road on left bank

Total Score _____

Versar INC.

Barnegat Bay Environmental Site Testing
Physical Characterization/Water Quality Field Data Sheet
(Front)

STREAM NAME Westecunk Cr.	LOCATION	
STATION # Downstream of Nutzo2	RIVER BASIN	
INVESTIGATORS M. Perot, S. Harriott		
FORM COMPLETED BY M. Perot	DATE 5-24-00 TIME 1640 AM (PM)	REASON FOR SURVEY Barnegat Site Testing

WEATHER CONDITIONS

Now		Past 24 hours
☐	storm (heavy rain)	☑
☐	rain (steady rain)	☐
☐	showers (intermittent)	☐
___%☐	%cloud cover	☐ ___%
☑	clear/sunny	☐

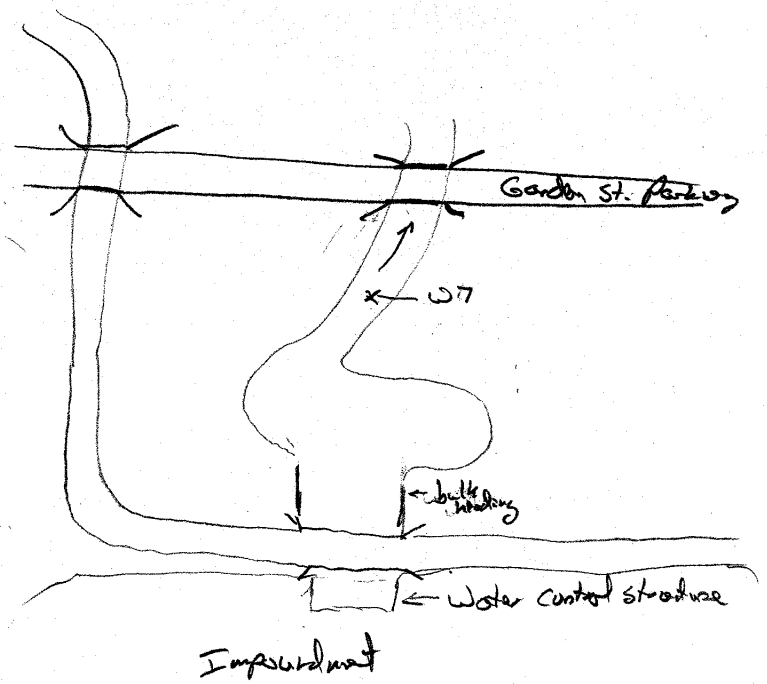
Has there been a heavy rain in the last 7 days? ☑ Yes ☐ No

Air Temperature 75 °C °F

Other _____

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)



STREAM CHARACTERIZATION

Stream Subsystem: ☑ Perennial ☐ Intermittent ☐ Tidal

Stream Type: ☑ Coldwater ☐ Warmwater (but quite warm after passing through impoundment)

Stream Origin: ☐ Glacial ☐ Spring-fed ☐ Non-glacial montane ☐ Mixture of origins ☑ Swamp and bog ☑ Other old cranberry bogs

Catchment Area _____ km²

Versar INC.

Barnegat Bay Environmental Site Testing
Physical Characterization/Water Quality Field Data Sheet (Back)

STATION # Downstream of NW502	DATE 5-24-00

WATERSHED FEATURES	**Predominant Surrounding Landuse** ☑ Forest ☐ Commercial ☐ Field/Pasture ☐ Industrial ☐ Agricultural ☑ Other Jackson Forge WMA ☐ Residential **Local Watershed NPS Pollution** ☐ No evidence ☑ Some potential sources ☐ Obvious sources active cranberry bog **Local Watershed Erosion** ☑ None ☐ Moderate ☐ Heavy
RIPARIAN VEGETATION (18 meter buffer)	**Indicate the dominant type and record the dominant species present** ☑ Trees ☐ Shrubs ☐ Grasses ☐ Herbaceous **dominant species present** AWC, red maple (less than 18m buffer on left side ≈ 10m)
INSTREAM FEATURES	**Estimated Reach Length** 300 ~~m~~ ft. **Estimated Stream Width** 30 ~~m~~ ft **Sampling Reach Area** _____ m² **Area in km² (m²x1000)** _____ km² **Estimated Stream Depth** 33 ~~m~~ inches **Surface Velocity (at thalweg)** _____ m/sec 10 ft/8 sec **Canopy Cover** ☐ Partly open ☐ Partly shaded ☑ Shaded **High Water Mark** 3 ~~m~~ ft above bank full **Proportion of Reach Represented by Stream Morphology Types** ☐ Riffle 5 % ☐ Run 60 % ☐ Pool 35 % **Channelized** ☑ Yes ☐ No beneath roads only **Dam Present** ☑ Yes ☐ No immediately upstream
LARGE WOODY DEBRIS	**LWD** _____ m² **Density of LWD** _____ m²/km² (LWD/ reach area)
AQUATIC VEGETATION	**Indicate the dominant type and record the dominant species present** ☐ Rooted emergent ☑ Rooted submergent ☐ Rooted floating ☐ Free floating ☐ Floating Algae ☐ Attached Algae **dominant species present** long, thick grass like plants **Portion of the reach with aquatic vegetation** 15 %
WATER QUALITY See NW502 datasheet W7	**Temperature** _____ °C **Specific Conductance** _____ mS/cm **Dissolved Oxygen** _____ mg/L **pH** _____ **Turbidity** _____ NTU **WQ Instrument Used** _____ **Water Odors** ☑ Normal/None ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Fishy ☐ Other _____ **Water Surface Oils** ☐ Slick ☐ Sheen ☐ Globs ☐ Flecks ☑ None ☐ Other _____ **Turbidity (if not measured)** ☐ Clear ☐ Slightly turbid ☐ Turbid ☐ Opaque ☑ Stained tannin reddish tinge ☐ Other _____
SEDIMENT/ SUBSTRATE	**Odors** ☑ Normal ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Anaerobic ☐ None ☐ Other _____ **Oils** ☑ Absent ☐ Slight ☐ Moderate ☐ Profuse **Deposits** ☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand ☐ Relict shells ☑ Other reddish tinged sediment - rust colored **Looking at stones which are not deeply embedded, are the undersides black in color?** ☐ Yes ☑ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	Diameter	% Composition in Sampling Reach	Substrate Type	Characteristic	% Composition in Sampling Area
Bedrock			Detritus	sticks, wood, coarse plant materials (CPOM)	10
Boulder	> 256 mm (10")				
Cobble	64-256 mm (2.5"-10")		Muck-Mud	black, very fine organic (FPOM)	70
Gravel	2-64 mm (0.1"-2.5")	30			
Sand	0.06-2mm (gritty)	50	Marl	grey, shell fragments	–
Silt	0.004-0.06 mm	20			
Clay	< 0.004 mm (slick)				

Versar INC.

BARNEGAT BAY ENVIRONMENTAL TESTING
WETLAND SITE DATA

Location ID/Name: TWS39 **Date:** 26 MAY 2000
Photo Rolls/Frames: ROLL #4 (IN PART), DISP. #1 **Crew:** SPH/MP
Weather conditions: SUNNY/P. CLOUDY **Air Temp.:** 75°F
NOTE CAMERA NON-FUNCTIONAL MIDWAY THROUGH ROLL #4

Sediment type(s) present: FINE TO MEDIUM SAND

Size of fill, berms, water control structures, etc.: SITE IS PRIMARILY FLAT TO SLIGHTLY ROLLING – ABOUT +/- 4 TO 5 FEET VARIATION OVER SITE. NO "FILL" PRESENT (?). LARGE LONG BREAKWALL PRESENT ON OCEAN SIDE.
* - PROBABLY NO NEED TO IMPORT ANY NEW FILL MATERIALS

Water Quality

Sampling Location	pH	Salinity (o/oo)	D.O. (mg/L)	Specific Conductivity (mS/cm)	Temp. (°C)	Turbidity (NTU)
WATER SAMPLING NOT PERFORMED						
NOT APPLICABLE						

Potential for fish passage? Y/N (if yes, complete instream and riparian data sheets and attach)

Wildlife observed: OSPREY, LAUGHING GULL, LEAST SANDPIPER, SPOTTED SANDPIPER, HOMO SAPIENS

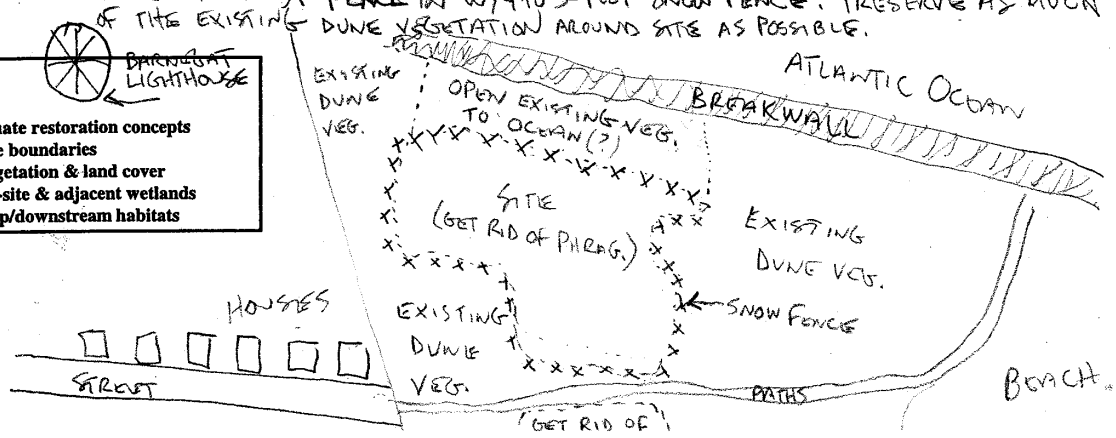
Potential impacts to existing systems: SOME AREAS OF BAYBERRY SHRUBS (SHOULD TRY TO PRESERVE), ALSO WALKING PATHS TO BEACH (PRIMARY ACCESS FOR RESIDENTS ON 5 STREETS).

Potential conflicting adjacent land uses: PRESERVE ACCESS PATHS TO BEACH. RESIDENCES ARE WITHIN 500 FT. OF SITE (POTENTIAL CONCERNS W/ HERBICIDES)

Notes and sketches: CREATE A U-SHAPED OPEN SITE, VEGETATED ON 3 SIDES (OPEN ON OCEAN SIDE). FENCE IN W/ 4 TO 5-FOOT SNOW FENCE. PRESERVE AS MUCH OF THE EXISTING DUNE VEGETATION AROUND SITE AS POSSIBLE.

Checklist

- √ re-evaluate restoration concepts
- √ map site boundaries
- √ map vegetation & land cover
- √ map on-site & adjacent wetlands
- N/A assess up/downstream habitats



Weston Inc.

BARNEGAT BAY ENVIRONMENTAL TESTING
ABANDONED LAGOON SITE DATA

Location ID/Name: LAC02 **Date:** 27 JUNE 2000
Photo Rolls/Frames: #1 **Crew:** SPH/FSK
Weather Conditions: SUNNY **Air Temp.:** 80°F

Size of fill, berms, water control structures, etc.: ① = 35 FT. AVERAGE ROAD WIDTH. ROAD IS 3 TO 5 FT. AVERAGE OVER ELEVATION OF EXISTING TIDAL MARSH, EXCEPT FOR LAST 120 FEET (SW END), WHICH HAS SEASONAL PILES 15 TO 18 FEET OVER EXISTING TIDAL MARSH. NOTE THAT THE OPEN WATER TO IMMEDIATE NORTH OF BIG PILES IS DEEP (POINT B).

Water Quality 23.5 o/oo IN BAY AT END OF FISHING ROAD

Sampling Location	pH	Salinity (o/oo)	D.O. (mg/L)	Specific Conductivity (mS/cm)	Temp. (°C)	Turbidity (NTU)	
W1 (@B)	7.42	12.85	7.59	21.49	27.7	22.5	(SURFACE)
W1 (@B)	7.31	12.51	2.24	20.81	19.51	24.1	(2.3 METERS)
W2	6.89	13.31	1.69	22.03	15.56	135.2	(3.79 METERS)
W3 (@G)	7.31	12.87	6.96	20.90	27.01	22.7	SURFACE)
W3 (@G)	7.23	12.93	1.90	21.46	17.69	24.3	(3.17 METERS)

IS ALSO
URITION
SHOOT
THER
INK

Bathymetric Survey NOTE: NOT TIDAL (AT REST, VERY MINIMALLY TIDAL)

Station #	Water depth - high tide (feet)	Water depth - low tide (feet)	Substrate (dominant grain size class)	Notes
A	15.3 FT	N/A	BLACK MUD	
B	8.0 FT.	—	BLACK MUD	
C	18 INCHES	—	BLACK MUD	
D	12.0 FT.	—	BLACK MUD	
E	18 INCHES	—	BLACK MUD	
F	13 FT.	—	BLACK MUD	
G	12.15 FT	—	BLACK MUD	
H	14.3 FT	—	BLACK MUD	
I	12.30 FT.	—	BLACK MUD	
J	16.30 FT	—	BLACK MUD	

BARNEGAT BAY ENVIRONMENTAL TESTING
ABANDONED LAGOON SITE DATA (CONT.)

Location ID/Name: LAC02 **Date:** 27 JUNE 2000

Beach seining results

Station #	Species observed	Notes
1 (OFF N MOST AREA OF #7)	SAME SPECIES FOR 2 STATIONS (GREATER NUMBERS IN #2)	THIS STATION #1 WAS MUCH DEEPER THAN #2 (≈ 10 FT MAX TO 2½ FT WHERE WE PULLED IN)
2 (IN LITTLE "BULB" AT THE SW END)	ATLANTIC SILVERSIDE SHEEPSHEAD MINNOW STICKLEBACK FUNDULUS HETEROCLITUS MENIDIA (X-LONG, BIG EYE)	- MANY OF ALL THESE SPP., EXCEPT NAKED GOBY - THIS STATION ≈ 5 FT TO 2½ FT.
	SHRIMPS FUNDULUS DIAPHANUS BLUE CRAB (SMALL, JUV.) NAKED GOBY (1)	- A NUMBER OF LARGE BLUE CRABS HERE @ STATION #2

Is SAV present? Y/N (if yes, map extent on aerial photograph)
Species present: POTAMOGETON SPP.

Wildlife observed: SHARP TAILED SPARROW, MARSH WREN, AMERICAN EGRET, SNOWY EGRET

Potential impacts to existing systems: EXISTING TIDAL MARSH SURROUNDS A MAJORITY OF THE SOUTHERN PART OF THE SITE. SOME SAV EXISTS IN THE SMALLER OPEN WATER AREAS OFF THE LAGOON.
Potential conflicting adjacent land uses: PAVED ROAD BOUNDS SITE TO THE N

Notes and sketches: THE BITING FLIES @ THIS SITE ARE HORRENDOUS! OUCH!! SITE IS APPARENTLY OWNED BY OCEAN COUNTY LAND TRUST.

Checklist

- ✓ re-evaluate restoration concepts
- ✓ map site boundaries
- ✓ map vegetation & land cover
- ✓ map on-site & adjacent wetlands
- ✓ map SAV

LAC02

27-June-00 12:50

Barnegat Bay opposite Bayville landlocked lagoon

Temp: 28.83 - °C
SpCond: 37.38 - mS/cm
Sal: 23.59 - ppt
DO: 7.86 - mg/L
Depth: 0.32 - m
pH: 8.07
Turb: 97.4 - NTU
DO% : 114.9

Margin pond adjacent to lagoon above

Temp 30.33 - °C
SpCond 26.70 - mS/cm
Sal 16.25 - ppt
DO: 6.60 - mg/L
Depth 0.63 - m
pH 7.62 -
Turb: 21.4 - NTU
DO% 95.7 - %

Versar INC.

*- BOB LYNE (MANAGER @ PAMP)

BARNEGAT BAY ENVIRONMENTAL TESTING
ABANDONED LAGOON SITE DATA

Location ID/Name: LAN06 **Date:** 27 JUNE 2000
Photo Rolls/Frames: DISP. 4 **Crew:** SPH/FSK
Weather Conditions: SUNNY **Air Temp.:** 85°F

Size of fill, berms, water control structures, etc.: AA - 21 FT ABOVE MARSH; 115 FT WIDE (SEE PROFILES UNDER NOTES)
=> NOTE VEG. ON BERMS IS ALMOST IDENTICAL TO BERMS AT LAN05 (SEE LAN05 DATA SHEET)

Water Quality

Sampling Location	pH	Salinity (o/oo)	D.O. (mg/L)	Specific Conductivity (mS/cm)	Temp. (°C)	Turbidity (NTU)	
W1 (W END)	6.17	28.88	1.43	44.81	11.33	40.5	(5.1 METERS)
W1A	7.30	21.84	9.50	34.85	28.02	28.8	(1.1 METERS)
*- NOTE ALSO THE 24-HOUR DATA FROM THE FIXED STATION							

Bathymetric Survey

Station #	Water depth - high tide (feet)	Water depth - low tide (feet)	Substrate (dominant grain size class)	Notes
A	15.00		BLACK MUD	
B	5.00		COARSE SAND/MUD	
C	15.00		BLACK MUD	
D	15.00		BLACK MUD	
E	13.00		BLACK MUD	
F	14.00		BLACK MUD	
G	14.00		BLACK MUD	
H	11.00		BLACK MUD	
I	5.00		COARSE SAND/MUD	
J	4.00		COARSE SAND	SMALL SHOAL AREA
K	11.00		BLACK MUD	

**- NOTE SIDES OF LAGOON BREAK FROM COARSE SAND TO MUD @ 5 FT.

BARNEGAT BAY ENVIRONMENTAL TESTING
ABANDONED LAGOON SITE DATA (CONT.)

Location ID/Name: LAN06 **Date:** 27 JUNE 2000

Beach seining results

Station #	Species observed	Notes
1 (SEE COPIED SECTIONS OF FISH KEY)	CTENOPHORE (MANY) ATLANTIC SILVERSIDE SHRIMP (ORANGE) FUNDULUS HET.	NEAR BIG CONCRETE SLAB ON SW SIDE OF LAGOON (SANDBAR EDGE)
2	MENHADEN BLUEFISH FUNDULUS HETEROCLITUS SILVERSIDE SPOT	MANY MORE FISH, FEWER CTENOPHORES, SAMPLE TAKEN ON W SIDE OF BEND NEAR SANDBAR
	CTENOPHORES BLUE CRAB (3 JUV. - SMALL) SHRIMP MUMICHOG STRIPED MULLET	

Is SAV present? Y/N (if yes, map extent on aerial photograph)
Species present: N/A

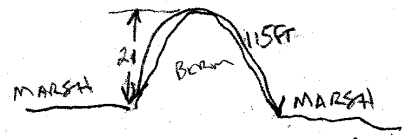
Wildlife observed: HERRING GULL, GBB GULL, GREEN HERON, BC NIGHT HERON (SEE ALSO SEINING RESULTS), DIAMONDBACK TERRAPIN

Potential impacts to existing systems: SITE IS BORDERED ON ALL SIDES BY TIDAL MARSH; CARE WOULD HAVE TO BE TAKEN TO PROTECT THESE.

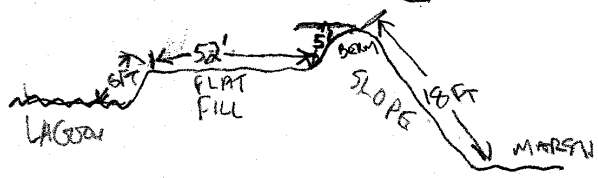
Potential conflicting adjacent land uses: NONE

Notes and sketches:

AA PROFILE



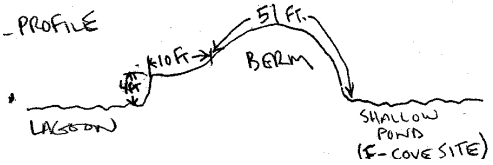
BB PROFILE



Checklist

- ✓ re-evaluate restoration concepts
- ✓ map site boundaries
- ✓ map vegetation & land cover
- ✓ map on-site & adjacent wetlands
- ✓ map SAV

PROFILE



=> SHOULD CONNECT THIS LAGOON TO THE F-COVE TO IMPROVE TIDAL FLUSHING, BUT AT THE SAME TIME KEEP BOAT ACCESS LIMITED. BECAUSE OF ITS INACCESSABILITY THIS LAGOON WOULD BE IDEAL FOR TERRAPIN & FISHERIES AMPHIBIANS

Date	Time	Temp	SpCond	DO Conc	pH	Turbidity	Chlorophyll	Fluorescen	DO%	Salinity
M/D/Y	hh:mm:ss	C	mS/cm	mg/L		NTU	ug/L	%FS	%	ppt
6/28/00	6:30:52	13.35	44.64	3.26	6.71	12.90	169.00	38.90	37.30	28.84
6/28/00	6:45:52	13.35	44.62	3.27	6.71	14.00	170.80	39.30	37.50	28.82
6/28/00	7:00:52	13.39	44.59	3.27	6.72	14.00	172.60	39.80	37.50	28.80
6/28/00	7:15:52	13.37	44.61	3.28	6.72	13.60	169.30	39.00	37.50	28.82
6/28/00	7:30:52	13.43	44.57	3.25	6.72	18.10	172.30	39.70	37.20	28.79
6/28/00	7:45:52	13.35	44.64	3.25	6.71	15.10	167.60	38.60	37.20	28.84
6/28/00	8:00:52	13.57	44.43	2.65	6.72	20.90	193.60	44.60	30.40	28.69
6/28/00	8:15:52	13.65	44.45	2.77	6.72	23.40	221.30	51.00	31.90	28.71
6/28/00	8:30:52	13.73	44.45	3.03	6.72	21.00	225.30	51.90	35.00	28.71
6/28/00	8:45:52	13.73	44.46	3.16	6.72	20.40	216.20	49.80	36.40	28.72
6/28/00	9:00:52	13.79	44.44	3.16	6.73	23.70	237.00	54.60	36.50	28.71
6/28/00	9:15:52	13.80	44.47	3.15	6.73	24.10	214.40	49.40	36.40	28.73
6/28/00	9:30:52	13.83	44.48	3.10	6.73	23.90	221.00	50.90	35.80	28.73
6/28/00	9:45:52	13.78	44.49	3.08	6.74	17.20	199.10	45.90	35.50	28.75
6/28/00	10:00:52	13.80	44.49	3.02	6.74	24.40	229.30	52.80	34.90	28.75
6/28/00	10:15:52	13.83	44.49	3.01	6.74	24.00	219.00	50.50	34.70	28.74
6/28/00	10:30:52	13.85	44.49	2.99	6.74	24.50	219.20	50.50	34.50	28.74
6/28/00	10:45:52	13.86	44.49	2.97	6.74	19.40	207.60	47.80	34.40	28.74
6/28/00	11:00:52	13.84	44.50	2.97	6.74	23.30	204.80	47.20	34.30	28.75
6/28/00	11:15:52	13.87	44.50	2.97	6.74	23.80	204.80	47.20	34.30	28.75
6/28/00	11:30:52	13.85	44.51	2.96	6.74	23.30	207.50	47.80	34.20	28.76
6/28/00	11:45:52	13.81	44.52	2.95	6.74	23.90	200.60	46.20	34.10	28.77
6/28/00	12:00:52	13.85	44.51	2.94	6.75	24.40	212.10	48.90	34.00	28.76
6/28/00	12:15:52	13.88	44.49	2.98	6.75	27.00	225.60	52.00	34.50	28.75
6/28/00	12:30:52	13.92	44.48	2.92	6.75	26.50	210.90	48.60	33.80	28.74
6/28/00	12:45:52	13.90	44.49	2.92	6.75	21.40	194.80	44.90	33.80	28.75
6/28/00	13:00:52	13.85	44.51	2.89	6.75	20.30	190.10	43.80	33.40	28.76
6/28/00	13:15:52	13.86	44.51	2.89	6.75	24.10	202.10	46.60	33.40	28.76
6/28/00	13:30:52	13.87	44.51	2.89	6.75	26.10	212.80	49.00	33.40	28.76
6/28/00	13:45:52	13.88	44.49	2.89	6.75	24.50	209.60	48.30	33.40	28.75
6/28/00	14:00:52	13.90	44.49	2.89	6.75	22.00	200.60	46.20	33.50	28.75
6/28/00	14:15:52	13.88	44.51	2.88	6.75	20.10	194.40	44.80	33.40	28.76
6/28/00	14:30:52	13.90	44.50	2.87	6.75	20.50	195.60	45.10	33.20	28.76
6/28/00	14:45:52	13.88	44.51	2.88	6.75	20.20	192.90	44.40	33.40	28.76
6/28/00	15:00:52	13.86	44.52	2.88	6.75	22.00	198.90	45.80	33.20	28.76
6/28/00	15:15:52	13.87	44.51	2.88	6.75	23.30	199.60	46.00	33.30	28.76
6/28/00	15:30:52	13.90	44.50	2.86	6.76	23.60	198.60	45.80	33.10	28.75
6/28/00	15:45:52	13.86	44.51	2.88	6.75	22.60	196.60	45.30	33.30	28.76
6/28/00	16:00:52	13.85	44.52	2.89	6.75	27.20	198.80	45.80	33.40	28.77
6/28/00	16:15:52	13.88	44.51	2.90	6.76	24.20	197.60	45.50	33.50	28.76
6/28/00	16:30:52	13.89	44.50	2.90	6.76	23.60	201.90	46.50	33.50	28.75
6/28/00	16:45:52	13.88	44.51	2.89	6.75	28.00	203.20	46.80	33.50	28.76
6/28/00	17:00:52	13.91	44.49	2.89	6.75	29.20	194.80	44.90	33.50	28.75
6/28/00	17:15:52	13.91	44.50	2.89	6.76	29.40	196.10	45.20	33.50	28.75
6/28/00	17:30:52	26.13	0.03	6.91	7.86	891.70	1.10	0.30	85.40	0.01

Date	Time	Temp	SpCond	DO Conc	pH	Turbidity	Chlorophyll	Fluorescen	DO%	Salinity
M/D/Y	hh:mm:ss	C	mS/cm	mg/L		NTU	ug/L	%FS	%	ppt
6/27/00	16:15:52	13.26	45.13	0.06	6.78	13.40	154.30	35.60	0.70	29.19
6/27/00	16:30:52	13.59	44.94	-0.78	6.82	17.70	178.30	41.10	-9.00	29.06
6/27/00	16:45:52	13.45	44.98	-1.02	6.82	18.60	167.20	38.50	-11.70	29.09
6/27/00	17:00:52	13.60	45.01	-0.83	6.82	18.40	173.30	39.90	-9.60	29.11
6/27/00	17:15:52	13.23	45.07	0.40	6.78	9.90	159.90	36.80	4.60	29.14
6/27/00	17:30:52	13.28	45.02	-0.08	6.77	15.90	173.30	39.90	-1.00	29.11
6/27/00	17:45:52	13.38	44.84	-0.07	6.76	12.30	159.60	36.80	-0.80	28.98
6/27/00	18:00:52	13.51	44.67	0.50	6.75	20.50	187.90	43.30	5.80	28.86
6/27/00	18:15:52	13.43	44.78	1.20	6.74	13.60	161.10	37.10	13.70	28.94
6/27/00	18:30:52	13.52	44.65	1.82	6.74	18.90	166.10	38.30	20.90	28.85
6/27/00	18:45:52	13.18	44.87	2.26	6.72	11.70	155.80	35.90	25.80	29.00
6/27/00	19:00:52	13.21	44.75	2.53	6.71	9.50	158.30	36.50	28.90	28.91
6/27/00	19:15:52	13.50	44.65	2.52	6.72	20.40	181.20	41.70	29.00	28.85
6/27/00	19:30:52	13.70	44.56	2.61	6.73	20.90	208.50	48.00	30.10	28.79
6/27/00	19:45:52	13.59	44.65	2.59	6.72	21.60	173.00	39.90	29.80	28.85
6/27/00	20:00:52	13.38	44.66	2.68	6.70	16.20	180.40	41.60	30.70	28.85
6/27/00	20:15:52	13.84	44.52	2.54	6.74	28.40	200.30	46.10	29.30	28.77
6/27/00	20:30:52	13.39	44.63	2.67	6.71	19.90	190.00	43.80	30.50	28.83
6/27/00	20:45:52	13.37	44.79	2.75	6.70	16.50	184.10	42.40	31.50	28.95
6/27/00	21:00:52	13.31	44.74	2.81	6.70	16.70	163.80	37.70	32.20	28.91
6/27/00	21:15:52	13.35	44.67	2.82	6.70	16.00	177.20	40.80	32.20	28.86
6/27/00	21:30:52	13.46	44.63	2.89	6.71	15.90	187.00	43.10	33.10	28.84
6/27/00	21:45:52	13.59	44.56	2.92	6.71	21.60	193.90	44.70	33.60	28.79
6/27/00	22:00:52	13.57	44.62	2.92	6.72	15.80	186.20	42.90	33.60	28.83
6/27/00	22:15:52	13.36	44.75	3.03	6.70	13.30	175.30	40.40	34.70	28.92
6/27/00	22:30:52	13.29	44.80	3.10	6.70	11.40	167.60	38.60	35.50	28.95
6/27/00	22:45:52	13.29	44.68	3.12	6.70	12.40	169.20	39.00	35.60	28.87
6/27/00	23:00:52	13.37	44.63	3.11	6.70	15.30	182.40	42.00	35.60	28.83
6/27/00	23:15:52	13.53	44.52	3.10	6.71	19.90	194.10	44.70	35.60	28.76
6/27/00	23:30:52	13.50	44.63	3.03	6.71	18.40	185.50	42.70	34.80	28.84
6/27/00	23:45:52	13.34	44.70	3.08	6.70	15.60	176.20	40.60	35.20	28.88
6/28/00	0:00:52	13.07	44.86	3.17	6.69	11.50	163.20	37.60	36.10	28.99
6/28/00	0:15:52	13.26	44.72	3.21	6.70	14.70	177.50	40.90	36.60	28.90
6/28/00	0:30:52	13.69	44.42	3.12	6.72	22.50	207.30	47.80	35.90	28.69
6/28/00	0:45:52	13.54	44.60	3.05	6.72	17.00	182.60	42.10	35.00	28.82
6/28/00	1:00:52	13.32	44.75	3.13	6.70	13.10	169.70	39.10	35.80	28.92
6/28/00	1:15:52	13.29	44.76	3.15	6.70	11.40	166.90	38.40	36.00	28.92
6/28/00	1:30:52	13.35	44.69	3.18	6.71	15.60	176.90	40.80	36.40	28.87
6/28/00	1:45:52	13.43	44.60	3.15	6.71	18.50	183.30	42.20	36.10	28.81
6/28/00	2:00:52	13.42	44.62	3.13	6.71	18.40	180.30	41.50	35.90	28.83
6/28/00	2:15:52	13.38	44.66	3.14	6.71	14.50	173.90	40.10	35.90	28.85
6/28/00	2:30:52	13.41	44.63	3.17	6.71	15.10	173.90	40.10	36.30	28.84
6/28/00	2:45:52	13.36	44.66	3.17	6.71	13.50	171.20	39.40	36.30	28.85
6/28/00	3:00:52	13.33	44.66	3.22	6.71	13.30	168.80	38.90	36.80	28.86
6/28/00	3:15:52	13.36	44.63	3.22	6.71	15.00	174.30	40.20	36.90	28.83
6/28/00	3:30:52	13.36	44.64	3.20	6.71	14.70	170.10	39.20	36.60	28.84
6/28/00	3:45:52	13.42	44.58	3.22	6.71	15.70	178.80	41.20	36.90	28.80
6/28/00	4:00:52	13.45	44.56	3.18	6.72	19.20	184.60	42.50	36.50	28.78
6/28/00	4:15:52	13.40	44.62	3.17	6.71	10.60	172.60	39.80	36.30	28.83
6/28/00	4:30:52	13.38	44.63	3.25	6.71	10.10	171.40	39.50	37.20	28.84
6/28/00	4:45:52	13.36	44.64	3.25	6.71	10.10	173.50	40.00	37.20	28.84
6/28/00	5:00:52	13.42	44.57	3.24	6.72	13.40	180.40	41.60	37.10	28.79
6/28/00	5:15:52	13.35	44.65	3.24	6.71	12.50	172.40	39.70	37.10	28.84
6/28/00	5:30:52	13.35	44.63	3.24	6.71	11.80	175.10	40.30	37.10	28.83
6/28/00	5:45:52	13.37	44.61	3.27	6.71	11.90	172.60	39.80	37.50	28.82
6/28/00	6:00:52	13.37	44.61	3.28	6.71	13.40	174.70	40.20	37.50	28.82
6/28/00	6:15:52	13.41	44.57	3.24	6.71	15.60	174.00	40.10	37.10	28.79

Lan06

6/30/00

Weston INC.

BARNEGAT BAY ENVIRONMENTAL TESTING
ABANDONED LAGOON SITE DATA

Location ID/Name: LAN05 **Date:** 1 JUNE 2000
Photo Rolls/Frames: DISP#2 **Crew:** FSK/SPH
Weather Conditions: SUNNY, HUMID **Air Temp.:** 75°F

Size of fill, berms, water control structures, etc.: A = 81 FT LONG, 15 FT HIGH; B = 80 FT LONG, 10 FT. HIGH C = 52 FT. LONG, 10 FT HIGH; D = 50 FT, 10 FT HIGH; E = 90 FT LONG, 20 FT HIGH; F = 90 FT LONG, 20 FT HIGH; G = 90 FT LONG, 30 FT HIGH, H = 75 FT LONG, 20 FT HIGH; I = 50 FT LONG, 10 FT HIGH; J = 50 FT. LONG, 10 FT HIGH; K = 49 FT, 10 FT HIGH; L = 49 FT, 10 FT HIGH; M = 50 FT LONG, 10 FT. HIGH, N = 51 FT, 10 FT HIGH; O = 45 FT LONG, 10 FT. HIGH

Water Quality

Sampling Location	pH	Salinity (o/oo)	D.O. (mg/L)	Specific Conductivity (mS/cm)	Temp. (°C)	Turbidity (NTU)	
W1 (SW CORNER OF ARM 2)	7.54	24.46	8.92	36.95	17.49	20.9	(DEPTH = 4 FT)
W2 (OFFSITE POND)	8.41	6.67	11.55	11.63	19.22	30.2	(= 12")
W3 (DEEP, MAIN CHAN OFF ARM 1)	7.25	29.18	8.30	45.02	13.99	27.0	(15.1 FT.)

Bathymetric Survey HIGH @ 11:50 AM / SAMPLING TIME BETWEEN 12:30 & 1:00 PM

Station #	Water depth - high tide (feet)	Water depth - low tide (feet)	Substrate (dominant grain size class)	Notes
B1	14	—	SILT	BLACK, ANOXIC, ODOROUS
B4	14	—	SILT	" "
B3	15	—	" "	" "
* B3A	10	—	SAND/SILT	WHERE SAND/SILT CHANGES
B2	15	—	SILT	BLACK ANOXIC ODOROUS
B5	16	—	" "	" "
B8	14	—	" "	" "
B7	15	—	" "	" " NOTE SAND BREAKS @ 10
B6	11	—	SAND	THIN LAYER OF MUD ON TOP
B9	13	—	SILT	BLACK, ANOXIC STINKS
B10	3.5 FT	—	MED. SAND	GRAY

* - NEED TO CALC. LOW TIDES

BARNEGAT BAY ENVIRONMENTAL TESTING
ABANDONED LAGOON SITE DATA (CONT.)

Location ID/Name: LAN05 **Date:** 1 JUNE 2000

Beach seining results

Station #	Species observed	Notes
S1 (ARM #2)	ATLANTIC SILVERSIDE (MENIDIA) RIGHT-EYE FLOUNDER SHRIMP (LONG ANTENNAE) CTENOPHORE BLUE CRAB	MENIDIA (VERY ABUNDANT) 6, EACH 1½" ABUNDANT 8, COMB-JELLY JUVENILE (SEVERAL) JUVENILE FISH VERY ABUNDANT IN GENERAL
S2 (ARM #1)	ATLANTIC SILV. BLUE CRAB CTENOPHORE SHRIMP [FLOUNDER - JUV, ESC. FROM NET]	≈ 100 SEV. JUVENILE 10 3
S3 (RT MOUTH)	FLOUNDER (R.E.) ATL. SILV. SHRIMP CTENOPHORE	7 40 6 12

Is SAV present? Y/N (If yes, map extent on aerial photograph)
Species present: TOO DEEP (W/STEEP DROPOFF)

Wildlife observed: DIAMONDBACK TERR. (10+), JUVENILE FISH V. ABUNDANT, MUSKRAT, YELLOW WARB, KINGBIRD, RW BLACKB., BC NIGHT HERON (6), COMMON YELL

Potential impacts to existing systems: SITE IS ADJACENT TO EXISTING WETLANDS WITHIN FORSYTHE NWR

Potential conflicting adjacent land uses: NONE

Notes and sketches: GILL-NETTING MAY BE APPROPRIATE HERE - COULD BE HABITAT FOR LARGER FISH

→ NOTE: DO TERRAPINS EAT CTENOPHORES?

Checklist
- ✓ re-evaluate restoration concepts
- ✓ map site boundaries
- ✓ map vegetation & land cover
- ✓ map on-site & adjacent wetlands
- ✓ map SAV N/A

BORDER VEG: BLACK CHERRY (LARGEST TO 10" DBH)
BAYBERRY
VA CREEPER
POISON IVY
JAP. HONEYSUCKLE
PHRAGMITES (LITTLE)
SMOOTH SUMAC
SASSAFRAS
RED CEDAR

Wetlands Inc.

*- NOTE DELORME CD SHOWS SITE AS BEING 115.69 ACRES

BARNEGAT BAY ENVIRONMENTAL TESTING
WETLAND SITE DATA

Location ID/Name: TWC21 **Date:** 25 MAY 2000
Photo Rolls/Frames: ROLL #3 **Crew:** SPH/MP
Weather conditions: P. CLOUDY **Air Temp.:** 70°F

Sediment type(s) present: COARSE SANDS/MEDIUM SANDS & GRAVEL IN OPEN AREA & MEDIUM-COARSE SANDS/COBBLES IN ALL OTHER AREAS

Size of fill, berms, water control structures, etc.: OPEN AREA IS ≈ 8 TO 10 FT ABOVE THE CREEK - AREA TO WEST IS APPROX 5 TO 6 FT. BELOW OPEN AREA. THE LARGE PHRAG AREAS TO THE EAST APPEAR TO BE 3 TO 5 FT. ABOVE MHW OF THE CREEK

Water Quality

Sampling Location	pH	Salinity (o/oo)	D.O. (mg/L)	Specific Conductivity (mS/cm)	Temp. (°C)	Turbidity (NTU)
NONE PERFORMED						
NOT APPLICABLE						

Potential for fish passage? Y/N (if yes, complete instream and riparian data sheets and attach)

Wildlife observed: OSPREY, SPOTTED SANDPIPER, BLACK RAT SNAKE (SEVERAL), WHITE-TAILED DEER (NOTE NO FOXES), MUTE SWANS (NE POND)

Potential impacts to existing systems: WETLANDS WITHIN LARGE EASTERN PARCELS. IS THIS AN "ACTIVE" PDF? WHAT ARE FUTURE PLANS?

Potential conflicting adjacent land uses: THE NE PART OF SITE IS WITHIN 500 FEET OF EXISTING RESIDENCES (REQUIRING CAUTION W/HERBICIDES)

Notes and sketches: AREA WEST OF OPEN HAS FINE-GRAINED (BLACK) SAND SUBSTRATE. GROUNDWATER IS NEAR SURFACE. PHRAG IS SOMEWHAT WEAK IN PLACES. HB BLUEBERRY IS ABUNDANT ALONG EDGES. SMALL RED MAPLES TO ≈ 4" DBH.

Checklist

- ✓ re-evaluate restoration concepts
- ✓ map site boundaries
- ✓ map vegetation & land cover
- ✓ map on-site & adjacent wetlands
- N/A assess up/downstream habitats

CONCEPT: CLEAR NARROW ROW OF VEG NEXT TO CREEK TO IMPROVE ACCESS FOR TERRAPINS & LINE OF SITE FOR BIRDS.
- EXPAND SANDY AREA TO THE WEST PARCEL?

- LARGE AREA EAST OF OPEN HAS COARSE SAND (DARK BROWN)/COBBLE SUBSTRATE. GROUNDWATER ≈ 1" FROM SURFACE

- EASTERN-MOST AREA HAS MEDIUM SANDS W/FEW COBBLES. NO WATER IN 15" HOLE. PHRAG VERY DENSE.

- NEED TO KEEP PEOPLE OUT OF SITE SOMEHOW.

/ EASTERN PHRAG PARCELS, GET RID OF PHRAG & PLANT AS A RESTOR SYSTEM, INTERSPERSED OPEN, HIGH SANDY AREAS

Weston Inc.

BARNEGAT BAY ENVIRONMENTAL TESTING
ISLAND SITE DATA

Location ID/Name: ISS08 **Date:** 2 JUNE 2000
Photo Rolls/Frames: DISP. #3 **Crew:** FSK/SMH
Weather Conditions: SUNNY, SW WIND **Air Temp.:** 75°F

Sediment type(s) present: MEDIUM TO COARSE SAND

Is wetlands or SAV present? Y/N (if yes, map extent on aerial photograph) ✓
Species present: ZOSTURA MARINA

Average height above mean high water: HIGHEST POINTS ARE 12 TO 15 FT. ABOVE MHW; AVERAGE IS 6 TO 8 FT. ABOVE MHW

Wildlife observed: HERRING GULL, GBB GULL, AM. OYSTERCATCHER, COMMON LOON, DC CORMORANT, MALLARD, FORSTERS TERN, COMMON TERN, SONG SPARROW

Potential impacts to existing systems: CURRENT NESTING. MAY BE 300-500 BIRDS CURRENTLY USING ISLAND.

Potential conflicting adjacent land uses: NONE, BUT MEASURES SHOULD BE TAKEN TO KEEP PEOPLE OFF THE ISLAND.

Notes and sketches: MANY BREEDING PAIRS, MOSTLY HERRING GULLS - SEVERAL GBB CHICKS OBSERVED. THREE BREEDING PAIRS OF OYSTER CATCHERS (ALMOST), 2 CHICKS. LOTS OF TERNS, BUT NONE ON THE ISLAND. DENSE SAV ON NE & NW SIDES OF ISLAND. LOTS OF HORSESHOE CRABS MATING/RUNNING. DEAD SKATE ON SE SIDE. NOTE THAT WATER VISIBILITY IS ± 10 FT AROUND THE ISLAND AT THE TIME OF THE FIELDWORK (SEEMS EXCEPTIONAL, COMPARED W/ OTHER SAV BEDS IN GEN. AREA, E.G. FLAT ISLAND, WHERE VISIBILITY WAS ONLY ABOUT 1 FOOT). WE DID NOT LAND ON THE ISLAND BECAUSE OF THE NESTING BIRDS. WE WATCHED AN UNMARKED HELICOPTER "BUZZ" THE ISLAND FOR AN UNKNOWN REASON (MANY BIRDS TOOK FLIGHT). SIMPLE PRESCRIPTION FOR RESTORATION WOULD BE TO HERBICIDE IT AROUND LABOR DAY (AFTER BREEDERS HAVE LEFT), THEN FLATTEN IT OUT WITH A SMALL PIECE OF EQUIPMENT IN THE WINTER (HELICOPTER IT ONTO AND OFF THE ISLAND?), AND INSTALL SEVERAL ROWS OF SNOW FENCING TO PROTECT IT FROM WEATHER & HUMANS. NO ADDITIONAL DREDGED MATERIALS ARE PROBABLY NEEDED IF THE ISLAND COULD BE FLATTENED (I.E., EVENED OUT) & SOMEWHAT PROTECTED. NOTE EXISTING VEGETATION ON ISLAND IS SOMEWHAT DIFFERENT THAN WHAT THE (10/98) AERIAL DEPICTS. VEGETATION IS DOMINATED BY BEACHGRASS, PHRAGMITES, BEACH HEATHER, BROMUS SP., SEASIDE GOLDENROD, AND SWITCHGRASS.

Checklist
- ✓ re-evaluate restoration concepts
- ✓ map site boundaries
- ✓ map vegetation & land cover
- ✓ map on-site & adjacent wetlands

* => NOTE TREACHEROUS SHOALING AROUND ISLAND MAKES ACCESS DIFFICULT!

Weston Inc.

BARNEGAT BAY ENVIRONMENTAL TESTING
ISLAND SITE DATA

Location ID/Name: IS602 **Date:** 31 MAY 2000
Photo Rolls/Frames: DISP. #2 **Crew:** SPH/FSK
Weather Conditions: SUNNY **Air Temp.:** 75°F

Sediment type(s) present: HIGHEST AREAS ARE WELL-DRAINED SAND; LOWEST AREAS ARE FINE-GRAINED SILT W/ H2O NEAR SURFACE

Is wetlands or SAV present? Y/N (if yes, map extent on aerial photograph)
Species present: ZOSTERA MARINA - SEE BELOW

Average height above mean high water: ≈ 4 TO 6 FEET ABOVE MHT (NOT INCLUDING HIGHEST AREAS)

Wildlife observed: SEASIDE SPARROW, RED FOX (ACTIVE DEN), SHARP-TAILED SPARROW, MALLARD DUCKS, WILLET, TOAD, YELLOW WARB, INDIGO BUNTING, FISH CROW

Potential impacts to existing systems: SOME AREAS OF WETLANDS (PRIMARILY PHRAG) ARE PRESENT. ESTABLISHMENT OF FORESTED OR SHRUB/SCRUB COULD REQUIRE SOME FILL IN THE WETTEST AREAS. SOME SAV IS ALSO PRESENT ON THE EAST SIDE OF THE ISLAND.
Potential conflicting adjacent land uses: NONE

Notes and sketches: DEFINITELY A FORMER DREDGE DISPOSAL ISLAND - THERE IS A SUBSTANTIAL BERM AROUND THE ENTIRE SITE. THE TOP OF THE BERM IS AN AVERAGE OF 8 TO 10 FEET ABOVE MHT WATER, AND IS UNIFORMLY 12 FT. WIDE. THE HIGHEST AREAS (NW & S ENDS) ARE FILLED 3 TO 5 FEET ABOVE THE BERM, AND ARE WELL-DRAINED SAND. THE LOWEST AREAS (NOT INCLUDING THE SMALL AREAS OF TIDAL MARSH) ARE ABOUT 6 TO 8 FEET BELOW THE TOP OF THE DIKE, AND POSSESS FINE-GRAINED SILT & H2O TO THE SURFACE IN MOST PLACES. OTHER HIGH SPOTS EXIST WHERE MATERIAL IS EVEN WITH THE TOP OF THE DIKE (N & NE PARTS OF SITE). ONE SMALL OPEN WATER POND, WHERE A LOCAL HUNTER SAID THEY HUNT DUCKS (MAINLY MALLARDS). ACTIVE FOX DEN IN HIGH OPEN AREA IN NW. NO OBVIOUS USE BY TERRAPINS. APPARENTLY BREEDING SEASIDE & SHARP-TAILED SPARROWS IN THE TIDAL MARSH ON THE WEST-CENTRAL EDGE. WE OBSERVED TWO RELATIVELY RECENT LARGE NESTS NEAR THE HIGH AREA IN THE SW. THESE WERE LIKELY FISH CROW NESTS BUT NOT CONFIRMED (THERE WERE A NUMBER OF FISH CROWS FLYING AND MAKING NOISE IN THE AREA OF THE NESTS). THIS ALL SUGGESTS THAT CONVERSION OF PHRAG AREAS TO FOREST & SHRUB/SCRUB COULD BE THE PRESCRIPTION. SPRAY MATURE, SPRAY PHRAG AGAIN, AND PLANT W/ TREES & SHRUBS. BROAD BAND OF SPARSE TO MODERATELY DENSE SAV ON NE & SE SIDES OF ISLAND. SUBSTRATE IS EVEN MIX OF SAND AND MUD. WATER DEPTH IN SAV BEDS IS ABOUT 24 TO 28 INCHES @ HIGH TIDE

Checklist

- ✓ re-evaluate restoration concepts
- ✓ map site boundaries
- ✓ map vegetation & land cover
- ✓ map on-site & adjacent wetlands

BARNEGAT BAY ENVIRONMENTAL TESTING
ISLAND SITE DATA

Location ID/Name: TS503 **Date:** 15 JUNE 2000
Photo Rolls/Frames: DIGP #5 **Crew:** KD + SPM
Weather Conditions: CLOUDY **Air Temp.:** 72°F

Sediment type(s) present: A = MEDIUM SAND (NO GROUND H2O); B = FINE SAND (H2O @ ≈ 18"); C = FINE SAND W/SHELLS (HIGH SPOT)

Is wetlands or SAV present? Y/N **(if yes, map extent on aerial photograph)**
Species present: WETLANDS AROUND OUTER EDGE – NOTED ONE AREA OF COMPLETELY SUBMERGED SPARTINA MARSH ON N SIDE.
Average height above mean high water: SEE BELOW

Wildlife observed: GREAT EGRET, BOAT-TAILED GRACKLE; WILLOW FLYCATCHER, RED FOX (DEN) LITTLE BLUE HERON (PERCHED ON TOP OF IGLOO)

Potential impacts to existing systems: MEASURES NEEDED TO PROTECT EXISTING TIDAL MARSH. SAV COULD BE IMPACTED. ALMOST NO WOODY VEGETATION PRESENT (EXCEPT POISON IVY AND IVA). (NOT LIKELY)
Potential conflicting adjacent land uses: NONE

Notes and sketches: MOST OF ISLAND SEEMS TO BE UPLAND - VARIES FROM MEDIUM SAND TO FINE SAND. FOUND OPEN, SANDY AREA (HIGH POINT OF ISLAND) – THIS SMALL AREA MAY BE ABOUT 6-8 FT ABOVE WATER. WE ESTIMATE THE AVERAGE HEIGHT ABOVE THE BAY IS 3-5 FT. (BASED ON VIEWS OF THE WATER FROM HIGH SPOT). NONE OF THE EXISTING WOODY VEGETATION SEEMS APPROPRIATE FOR COLONIAL NESTING BIRDS. THE EXISTING HIGH OPEN SPOT IS PROBABLY TOO ISOLATED AND TOO SMALL TO BE IMPORTANT FOR DIAMONDBACK TERRAPINS. THIS SITE SEEMS AN IDEAL CANDIDATE TO RECEIVE SOME SANDY DREDGED MATERIALS. COULD THE MATERIAL COME FROM TWS15, TWS17, AND TWS18? APPROACH BY BOAT IS EASIEST ON NW SIDE. THE E AND NE SIDES SHOULD BE AVOIDED DURING CONSTRUCTION BECAUSE OF SHALLOWS AND SAV.

Checklist
- ✓ re-evaluate restoration concepts
- ✓ map site boundaries
- ✓ map vegetation & land cover
- ✓ map on-site & adjacent wetlands

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BARNEGAT BAY ENVIRONMENTAL TESTING
WETLAND SITE DATA

Location ID/Name: TWS25 **Date:** 13 JUNE 2000
Photo Rolls/Frames: DSR #4 **Crew:** SPH & TJ
Weather conditions: P. CLOUDY **Air Temp.:** 72°F

Sediment type(s) present: SILT (THROUGHOUT)

Size of fill, berms, water control structures, etc.: ONLY DISCERNABLE BERM IS ON WEST CREEK SIDE (S SIDE) OF SITE. THE HIGHEST AREAS ARE ON THE BERM AND THE AREA BETWEEN THE BERM AND WEST CREEK. THESE AREAS ARE 2 TO 3 FEET ABOVE THE SURROUNDING MARSH. AREAS #4 ARE ABOUT 1 FOOT ABOVE EXISTING MARSH; AREA 3 IS LESS THAN 1 FOOT ABOVE EXISTING MARSH.

Water Quality

Sampling Location	pH	Salinity (o/oo)	D.O. (mg/L)	Specific Conductivity (mS/cm)	Temp. (°C)	Turbidity (NTU)
NOT PERFORMED - SEE NOTES FOR TWS23 & TWS24.						

Potential for fish passage? Y/N (if yes, complete instream and riparian data sheets and attach)

Wildlife observed: SHARP-TAILED SPARROW, L.B. MARSH WREN

Potential impacts to existing systems: EXISTING UNDITCHED MARSH SURROUNDS SITE.

Potential conflicting adjacent land uses: RESIDENCES ARE ONLY ABOUT 200-250 FT. TO S

Notes and sketches: SITE IS BORDERED BY RELATIVELY NICE (I.E., UNDITCHED) BRACKISH MARSH - THIS WOULD BE THE MAIN IMPETUS FOR A PROJECT HERE. WOULD JUST REMOVING THE BERM AND HERBICIDING THE PHRAG WORK (SEVERAL TIMES) HERE? NOTE THAT THE TIDAL CREEK TO THE EAST IS LARGE & FAIRLY NAVIGABLE (SEE WQ DATA ON TWS15 DATA SHEET).

Checklist

- ✓ re-evaluate restoration concepts
- ✓ map site boundaries
- ✓ map vegetation & land cover
- ✓ map on-site & adjacent wetlands
- ✓ assess up/downstream habitats

BARNEGAT BAY ENVIRONMENTAL TESTING
WETLAND SITE DATA

Location ID/Name: TWS24 **Date:** 29 JUNE 2000
Photo Rolls/Frames: DISP. #6 **Crew:** SPH/FSK
Weather conditions: CLOUDY / RAIN **Air Temp.:** 72°F

Sediment type(s) present: SILT (PRIMARILY) / VERY FINE SAND

Size of fill, berms, water control structures, etc.: ONLY BERM IS ALONG S (CREEK) SIDE OF SITE; IT IS ABOUT 5 FEET ABOVE EXISTING ADJACENT TIDAL MARSH, AND IS ALONG THE FULL LENGTH OF THE SITE. TOP OF SITE (OPEN SANDY AREA) IS ABOUT 8 TO 10 FT. ABOVE EXISTING MARSH. WET AREAS WITHIN #5 AND #3 MAY ONLY BE ABOUT 1 FOOT ABOVE EXISTING MARSH. AREA #4 IS ABOUT 5 FEET ABOVE MARSH; AREA #7 IS 3 TO 5 FT. ABOVE MARSH.

Water Quality

Sampling Location	pH	Salinity (o/oo)	D.O. (mg/L)	Specific Conductivity (mS/cm)	Temp. (°C)	Turbidity (NTU)
W1 (SITE)	7.01	18.48	7.41	29.53	23.86	33.2 (0.155 METER)
W2 (NEAR RAMP)	7.54	7.04	7.19	12.15	23.63	25.1 (SURF)
W3 (SAME AS W2)	7.12	16.46	5.02	27.06	25.08	N/A (1 METER)

Potential for fish passage? Y/N (if yes, complete instream and riparian data sheets and attach)

Wildlife observed: HERRING GULL, SHARP-TAILED SPARROW, MD YELLOWTHROAT, MARSH WREN

Potential impacts to existing systems: SITE IS SURROUNDED ON ALL SIDES (EXCEPT CREEK SIDE) BY RELATIVELY NICE TIDAL MARSH (ALTHOUGH IT IS GRID-DITCHED). CARE MUST BE TAKEN TO AVOID IMPACTS.

Potential conflicting adjacent land uses: EXISTING RESIDENCES ABOUT 200 TO 300 FT. TO SW (ACROSS THE CREEK). CARE WOULD HAVE TO BE TAKEN WHEN SPRAYING HERBICIDES.

Notes and sketches: THE DRIEST PARTS OF THE SITE ARE #4 & #6; #7 IS ALSO SOMEWHAT HIGH, AND APPEARS TO BE ALL UPLAND. MOST ALL AREAS WITHIN #5 ARE SATURATED & ARE COVERED WITH SOLID, TALL, ROBUST PHRAGMITES. THIS SITE IS PARTICULARLY DIFFICULT TO NAVIGATE THROUGH. PHRAG COULD BE REMOVED ON N AND SW PARTS OF SITE BY RE-INTRODUCING TIDAL FLOW FROM CREEK (NOTE SALINITY). THE HIGH AREAS NEAR THE CENTER AND SE PARTS OF THE SITE COULD BE HERBICIDED AND BUILT UP WITH ADDITIONAL SANDY MATERIALS. THESE "OPENED UP" AREAS MAY BE GOOD LOCATIONS FOR DIAMONDBACK TERRAPINS AND BEACH NESTING BIRDS.

Checklist

- ✓ re-evaluate restoration concepts
- ✓ map site boundaries
- ✓ map vegetation & land cover
- ✓ map on-site & adjacent wetlands
- ✓ assess up/downstream habitats

BARNEGAT BAY ENVIRONMENTAL TESTING
WETLAND SITE DATA

Location ID/Name: TWS24 **Date:** 14 JUNE 2000
Photo Rolls/Frames: DISP. #4 **Crew:** SPH & TJ
Weather conditions: CLOUDY **Air Temp.:** 75°F

Sediment type(s) present: A = FINE SAND (ON HIGH AREAS #4 & #6); SILT EVERYWHERE ELSE

Size of fill, berms, water control structures, etc.: BERMS NOT REALLY APPARENT (SEE NOTES ON SITE TWS23). AREA #3 AND THE NORTHERN-MOST PARTS OF #5 (BACK OF SITE) ARE VERY WET, AND APPEAR TO BE ONLY A FEW INCHES OVER ADJACENT "UNDISTURBED" TIDAL MARSH. AREAS #4 ARE ABOUT 2 FEET ABOVE "UNDISTURBED" MARSH; AREA #6 IS ABOUT 3 TO 5 FEET ABOVE THE "UNDISTURBED" MARSH.

Water Quality

Sampling Location	pH	Salinity (o/oo)	D.O. (mg/L)	Specific Conductivity (mS/cm)	Temp. (°C)	Turbidity (NTU)
NONE PERFORMED – NOT APPROPRIATE FOR THIS SITE						
↳ SEE WATER CHEMISTRY FROM ADJACENT WESTECUNK CREEK ON						
TWS15 DATA SHEET. NOTE SALINITY MAY BE HIGH ENOUGH						
HERE TO WEAKEN/GET RID OF PHRAG.						

Potential for fish passage? Y/N (if yes, complete instream and riparian data sheets and attach)

Wildlife observed: WILLET, SHARP-TAILED SPARROW, LB MARSH WREN, LAUGHING GULL, HERRING GULL

Potential impacts to existing systems: EXISTING "UNDISTURBED" TIDAL WETLANDS (DITCHED)

Potential conflicting adjacent land uses: NONE

Notes and sketches: LIKE TWS23, COULD BE A DIFFICULT SITE TO IMPLEMENT. MATERIAL COULD BE ADDED TO HIGH SPOTS, BUT THEY ARE SURROUNDED BY WETLANDS (ALTHOUGH IT IS ALMOST ALL PHRAGMITES). COULD CUT A NEW E-W CHANNEL THROUGH SITE, CONNECTING THE SEPARATE TIDAL CREEKS TO THE E AND W. SALINITY IS ABOUT 18 PARTS IN THE MAINSTEM CREEK HERE (SHOULD KILL PHRAG). MATERIAL FROM NEW CHANNEL COULD BE PUT ON TOP TO EXPAND AREA #6. SUCH A SCENARIO COULD ALSO IMPROVE AREA #3 BY GETTING RID OF PHRAG (WHERE IT IS ALREADY WEAK IN MOST AREAS).

Checklist
- ✓ re-evaluate restoration concepts
- ✓ map site boundaries
- ✓ map vegetation & land cover
- ✓ map on-site & adjacent wetlands
- ✓ assess up/downstream habitats

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BARNEGAT BAY ENVIRONMENTAL TESTING
WETLAND SITE DATA

Location ID/Name: TWS23 **Date:** 14 JUNE 2000
Photo Rolls/Frames: DISP. #4 **Crew:** SPH/TJ
Weather conditions: CLOUDY **Air Temp.:** 75°F

Sediment type(s) present: A = MEDIUM SAND B = OYSTERSHELLS
↳ OTHER AREAS WITH WET SILT

Size of fill, berms, water control structures, etc.: BERMS ARE NOT REALLY APPARENT ANYWHERE ON SITE - (COULD BE COMBINATION OF BEING FILLED TO TOP & EROSION, BUT THERE MAY HAVE NEVER BEEN ANY BERM AT ALL). AVE. HEIGHT OF AREA #2 OVER MARSH IS 1.5 TO 2 FEET; AVE HEIGHT OF AREA #3 IS 2 TO 3 FT. ABOVE MARSH; AREA #4 IS 3 TO 5 FEET ABOVE MARSH.

Water Quality

Sampling Location	pH	Salinity (o/oo)	D.O. (mg/L)	Specific Conductivity (mS/cm)	Temp. (°C)	Turbidity (NTU)
NONE PERFORMED - NOT APPROPRIATE FOR THIS SITE						
↳ CHEMISTRY OF SMALL TIDAL STREAM SIMILAR TO MAIN						
CHANNEL OF WESTECUNK CREEK						

Potential for fish passage? Y/N (if yes, complete instream and riparian data sheets and attach)

Wildlife observed: FISH CROW, GBB GULL, HERRING GULL, YELLOW WARBLER, COMMON YELLOWTHROAT

Potential impacts to existing systems: EXISTING WETLANDS (PARTICULARLY IN NE SECTION)

Potential conflicting adjacent land uses: NONE

Notes and sketches: THIS COULD BE A DIFFICULT SITE TO IMPLEMENT, DEPENDING ON HOW AGENCIES VIEW "WETLANDS IMPACTS." MATERIAL COULD BE ADDED TO THE HIGHEST SPOTS (SEE #3 & #4 ON PHOTO). FOR A LARGER PROJECT, A SMALL QUANTITY OF FILL COULD BE ADDED TO PROVIDE DRIER CONDITIONS FOR ESTABLISHING A FORESTED SYSTEM (COLONIAL NESTING BIRDS?). COULD ALSO DIG A CHANNEL THROUGH THE NE PART OF THE SITE TO ESTABLISH TIDAL CIRCULATION IN THIS AREA. CHANNEL COULD CONNECT TWO BOWLS IN THE LITTLE TIDAL CREEK BEHIND THE SITE. MATERIAL FROM CHANNEL-CUTTING COULD BE PUT ON HIGH AREA.

Checklist

- ✓ re-evaluate restoration concepts
- ✓ map site boundaries
- ✓ map vegetation & land cover
- ✓ map on-site & adjacent wetlands
- ✓ assess up/downstream habitats

Wetlands Inc.

BARNEGAT BAY ENVIRONMENTAL TESTING
WETLAND SITE DATA

Location ID/Name: TWS18 **Date:** 14 JUNE 2000
Photo Rolls/Frames: DISP. # 4 **Crew:** SPH/TJ
Weather conditions: CLOUDY **Air Temp.:** 70°F

Sediment type(s) present: COARSE SAND

Size of fill, berms, water control structures, etc.: A = 116 FT.; DEPTH TO GROUND H_2O @ A = 2 FT, 1.5 INCHES; B = 201 FT.; C = 485 FT.; D = 118 FT.; DEPTH TO GROUND H_2O @ D = 8 INCHES; AVE HEIGHT OF FILL NEAR D (SE CORNER OF SITE) IS ≈ 5-6 INCHES; AVE HEIGHT OF FILL NEAR A IS 2½ TO 3 FEET ABOVE MARSH TO THE NW.

Water Quality

Sampling Location	pH	Salinity (o/oo)	D.O. (mg/L)	Specific Conductivity (mS/cm)	Temp. (°C)	Turbidity (NTU)	
W1 (WEST CREEK SEE W1 TWS15)	7.01	13.90	4.63	22.58	20.42	31.1	(DEPTH 5 FT.)
W2 (SEE W3 FROM YESTERDAY)	7.09	5.61	3.96	9.959	19.07	23.7	(DEPTH 3.1 FT.)

Potential for fish passage? Y/N (if yes, complete instream and riparian data sheets and attach)

Wildlife observed: SHARP-TAILED SPARROW, SEASIDE SPARROW, WT DEER, MARSH WREN, RACCOON

Potential impacts to existing systems: THIS SITE HAS THE LARGEST AREA OF NON-PHRAG FW WETLANDS (IMMED. TO N).

Potential conflicting adjacent land uses: RESIDENCES ACROSS THE CREEK TO S/SE. SHOULD NOT BE A PROBLEM FOR HELICOPTER SPRAYING IF WEATHER CONDITIONS ARE PROPERLY MONITORED.

Notes and sketches:

* => SEE TWS15 DATA SHEET FOR NOTES

NOTE REMAINS OF OLD CRAB OPERATION ON SE END OF SITE. THE LENGTH OF THIS PART OF THE IS REPRESENTED BY "B." THIS AREA POSSESSES MUCH LESS FILL; DEPTH TO GROUND H20 IS AVE OF ≈ 8" (WATER IS AT SURFACE IN ADJACENT MARSH).

THE WATER CHEMISTRY OF THE SMALL TIDAL CREEKS SEEMS SOMEWHAT VARIABLE, AND MERITS SOME FURTHER STUDY. THERE WAS AN OBVIOUS "SALT WEDGE" ON WESTECUNK CREEK, WITH THE FRESH WATER ON THE FIRST FEW FEET, AND SALTIEST ON THE BOTTOM, 4-6 FT. THE SMALL CREEKS SEEM TO BE MORE COMPLETELY MIXED (THEY ARE SHALLOW). BLUE CRABS APPEAR TO BE VERY ABUNDANT IN THE SMALL TIDAL CREEKS.

Checklist

- ✓ re-evaluate restoration concepts
- ✓ map site boundaries
- ✓ map vegetation & land cover
- ✓ map on-site & adjacent wetlands
- ✓ assess up/downstream habitats

** => THE LARGE PARCEL OF NON-PHRAG WETLANDS TO THE N OF THIS SITE SHOULD BE USED AS A "BASELINE" FOR RESTORATION OF THE 3 SITES.

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BARNEGAT BAY ENVIRONMENTAL TESTING
WETLAND SITE DATA

Location ID/Name: TWS17 **Date:** 13 JUNE 2000
Photo Rolls/Frames: DISP# 3 **Crew:** SPH/TJ
Weather conditions: CLOUDY/INT. RAIN **Air Temp.:** 62° F

Sediment type(s) present: COARSE SAND, W/COBBLES TO 2"

Size of fill, berms, water control structures, etc.: A = 192 FT. AVERAGE HIGH AREAS ARE 4 TO 4½ FT. ABOVE MARSH SUBSTRATE; LOW AREA IN MIDDLE OF FILL IS 2½ TO 3 FT.; ABOUT ⅔ OF SITE IS WITHIN THE HIGH AREA (⅓ WITHIN LOW AREA), SO AVG. IS 4 TO 4½ FEET
B = 360 FT.

Water Quality

Sampling Location	pH	Salinity (o/oo)	D.O. (mg/L)	Specific Conductivity (mS/cm)	Temp. (°C)	Turbidity (NTU)
W1 (TIDAL CUT TO NW)	6.56	2.40	4.81	4.436	19.95	40.1

(DEPTH 2½ FT.)

Potential for fish passage? Y/N (if yes, complete instream and riparian data sheets and attach)

Wildlife observed: MUSKRAT, SEASIDE SPARROW, LB MARSH WREN, WT DOOR, RACCOON (NOTE RACCOON SCATS CONSISTING SOLELY OF CRAB SHELLS)

Potential impacts to existing systems: EXISTING FRESHWATER WETLANDS (NON-PHRAG) TO THE N OF THE SITE ARE LARGE AND VERY NICE.

Potential conflicting adjacent land uses: RESIDENCES ACROSS THE CREEK TO S/SE. SHOULD NOT BE A PROBLEM FOR SPRAYING IF WEATHER CONDITIONS ARE PROPERLY MONITORED.

Notes and sketches: GROUND H2O AT ≈ 2½ TO 3 FT FROM HIGH SPOTS SURFACE (DUG HOLES IN LOW SPOT & HIGH SPOT)
↳ SOME CAPILLARY ACTION PROBABLY PRESENT

⇒ SEE TWS15 DATA SHEET FOR NOTES

Checklist

- ✓ re-evaluate restoration concepts
- ✓ map site boundaries
- ✓ map vegetation & land cover
- ✓ map on-site & adjacent wetlands
- ✓ assess up/downstream habitats

⇒ IT WOULDN'T BE TOO SURPRISING IF MARSH BIRDS (ESP. KING RAILS) USED THESE BACK MARSHES FOR BREEDING

WE NOTED A NUMBER OF MUSKRATS RESIDE IN THE NON-PHRAG MARSH TO THE NORTH OF THIS SITE. THEY SEEM TO EAT THE THREESQUARE AND NL CATTAILS. L.B. MARSH WRENS NEST ALONG THE LITTLE TIDAL CREEKS HERE (WE OBSERVED 5 NESTS). SOME OF THE FEATURES THAT LOOK LIKE SMALL STREAMS ON THE AERIAL ARE REALLY MUSKRAT RUNS. BECAUSE OF THE MUSKRATS IT MAY NOT BE WISE TO ACTUALLY INSTALL ANY PLANTS AT THESE SITES. TOO BAD MUSKRATS DON'T EAT PHRAG!

BARNEGAT BAY ENVIRONMENTAL TESTING
WETLAND SITE DATA

Location ID/Name: TWS15 **Date:** 13 JUNE 2000
Photo Rolls/Frames: DISP #3 (END), DISP #4 **Crew:** SPHY TJ
Weather conditions: CLOUDY **Air Temp.:** 68°F

Sediment type(s) present: COARSE SAND (DEEP ORGANIC SUBSTRATE IN MARSH)

Size of fill, berms, water control structures, etc.: A = 143 FT.; DEPTH TO GROUND H_2O @ A = 14"; DEPTH TO GROUND H_2O AT HIGH POINT = 36" (WE ESTIMATE MARSH SURFACE IS ≈ 18" DEEPER THAN THIS); AVE. HEIGHT OF FILL ABOVE MARSH IS 6 FT. (MEASURED); THERE ARE ALSO A FEW SPOTS THAT ARE JUST OVER 7 FT. ABOVE MARSH; B = 821 FT.; C = 215 FT.; D = 137 FT.

Water Quality

Sampling Location	pH	Salinity (o/oo)	D.O. (mg/L)	Specific Conductivity (mS/cm)	Temp. (°C)	Turbidity (NTU)	
W1 (WEST CREEK-MAIN)	7.12	0.71	7.54	1.349	19.92	25.1	(SURFACE)
W2 (TIDAL CREEK TO E)	6.50	3.02	6.48	5.553	20.75	48.5	(DEPTH 3 FT.)
W3 (BIG TIDAL CREEK TO E OF TWS18)	6.45	6.71	6.12	11.72	20.66	24.7	(DEPTH 1 FT.)
W4 (WEST CREEK, TWS24)	6.45	18.30	3.89	29.35	21.33	26.3	(DEPTH 4 FT.)
W5 (WEST CREEK MOUTH)	7.20	24.10	7.92	38.04	20.87	80.3	(DEPTH 6 FT.)

Potential for fish passage? Y/N (if yes, complete instream and riparian data sheets and attach)

Wildlife observed: ONE DIAMONDBACK SCRAPE W/EGG, RACCOON, WT. DEER, DOGS. L.B. MARSH WRENS (EVERYWHERE) → (EGG WAS RUPTURED + OUTSIDE SCRAPE - FILLED W/ ANTS)

Potential impacts to existing systems: EXISTING FRESHWATER WETLANDS (NON-PHRAG) ARE INTERSPERSED (PRIMARILY TO W AND N).

Potential conflicting adjacent land uses: RESIDENCES ACROSS THE CREEK, TO S/SE. SHOULD NOT BE A PROBLEM FOR SPRAYING IF WEATHER CONDITIONS ARE PROPERLY MONITORED.

Notes and sketches: HERBICIDE SPRAYING WOULD HAVE TO BE CONDUCTED CAREFULLY (BY HELICOPTER), PREFERABLY WITH NO WIND OR SLIGHT WIND FROM SOUTH (NOT NORTH). A FEW RESIDENCES ARE CLOSE, 300-500 FT. TO S/SE. WOULD BE BEST TO HAVE A KNOWLEDGEABLE ECOLOGIST AS PART OF HELICOPTER SPRAY TEAM. NONE OF THESE SITES (15, 17, 18) APPEAR TO PROVIDE SIGNIFICANT UPLAND HABITATS FOR TERRESTRIAL FAUNA. THEIR FLORA IS PARTICULARLY UNINTERESTING. IT WOULD MAKE A LOT OF SENSE TO REMOVE THESE FILL PILES AND GET RID OF AS MUCH PHRAGMITES AS POSSIBLE.

Checklist
- ✓ re-evaluate restoration concepts
- ✓ map site boundaries
- ✓ map vegetation & land cover
- ✓ map on-site & adjacent wetlands
- ✓ assess up/downstream habitats

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APPENDIX C

COLOR GROUND-LEVEL PHOTOGRAPHS

(INCLUDED ON ACCOMPANYING CD)

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